Modular Reconfigurable C4I Interface (MRCI)

In Progress Review (IPR)

AGENDA (1 of 4)

0830-0845	**Welcome, Introduction, and Recent Activity Summary**	**Maj. Zeswitz C. Keune M. Cosby**
0845-0915	**Issues addressed by the MRCI Experiments**	**C. Keune M. Cosby**
0915-0935	**Experimental Test Federation Configurations**	**M. Cosby**
0935-1020	**Prototype MRCI Design Summary Overall Design Module Architecture Translation Design Communication Degradation Design**	**M. Hieb/K. Thumim/B. Silva**
1020-1035	**Prototype MRCI Implementation and Development Approach Summary**	**L. Griggs**
1035-1050	**Break**	

AGENDA (2 of 4)

1050-1200	**Prototype MRCI (V1.3) Development Status** **C4I System Capabilities (including SOMs)** **-AFATDS** **-MCS/P Baseline** **-CTAPS** **Simulation Capabilities** **-CBS** **-AFSAF** **-ARSAF** **-CCTT** **ACESS Development** **Testing Program**	**L. Griggs/M. Hieb**
1200-1300	**Lunch**	

AGENDA (3 of 4)

1300-1400	**Application of Quality Factors to the Evaluation of the MRCI Prototype** **Functionality** **Usability** **Reliability** **Maintainability** **Availability** **Flexibility** **Portability** **Testability** **Reusability [Special Emphasis Area]** **Context** **Modules**	**L. Griggs/M. Hieb**
1400-1430	**The Way Ahead**	**M. Cosby**

AGENDA (4 of 4)

1430-1700 MRCI Experiment Testbeds

- **MCS/P - ARSAF**
- **MCS/P - CBS**
- **MCS/P - CCTT**
- **CTAPS - Test Cell (CCSIL W/S)**
- **AFATDS - Test Cell (CCSIL W/S)**
- **ACESS**

MRCI Program Overview

Major Steve Zeswitz, DMSO
Cindy Keune, NRaD

Key MRCI Events Up To DOC

Interim System Requirements Review [ISRR]	21/22 Feb 96
System Requirements Review [SRR]	23 Apr 96
Informal Technical Interchange [ITI]	22 May 96
Preliminary Design Review [PDR]	11 Jun 96
Informal Technical Interchange [ITI]	16 Jul 96
Test Planning Workshop	17 Jul 96
Critical Design Review [CDR]	14 Aug 96
Community Survey re: MRCI ‘97 Requirements	1 Sep 96
In Progress Review [IPR]	11 Oct 96
Informal Technical Interchange [ITI]	25 Oct 96
STOW CT4 Participation	16/20 Dec 96
ITI and Pre-Test Readiness Review [PTRR]	18 Dec 96
Test Readiness Review [TRR]	15 Jan 97
Demonstration of Operating Capability [DOC]	19 Feb 97

Recent Activity Summary: Progress Since DOC (1 of 2)

19 Feb.	MRCI Demonstration of Capability hosted in Advanced Simulation and Technology Center McLean.
25 Feb.	Traveled to Ft. Monmouth to brief CECOM and MITRE on Comm Degradation papers to be presented at the Simulation Interoperability Workshop and discussed Modeling changes reqmts.
27 Feb.	Deployed to JTASC in Suffolk for CT 97 participation. Set up MCS/P, AFATDS to CBS link via MRCI.
3 -6 Mar.	Demonstrated MCS/P, AFATDS to CBS link via MRCI outside the CT 97 testing. Showed interaction between CBS and C4I systems.
4 Mar.	Attended the HLA C2 Objectives Meeting in Orlando.
5 Mar.	We traveled to Orlando and presented 5 MRCI papers during the Simulation Interoperability Workshop.
18 Mar.	Participated in the RTI Performance Meeting at DMSO.
19 Mar.	Conducted an aWOC coordination Meeting in Orlando.
24 Mar.	Participated in the Federation Management Technical Exchange at DMSO.

Recent Activity Summary: Progress Since DOC (2 of 2)

3 Apr.	Participated in the STOW, Communications Working Group and Exercise Initialization Working Group.
3 Apr.	Participated in the OMDT user's group where the status of the automated tools for FOM development briefed at DMSO.
9-10 Apr.	Attended the Architecture Management Group-18 meeting.

Current Major Experiment Thrusts

- **HLA/C2 Testbed**
- **IV & V by NRaD**
- **STOW & JTC Prairie Warrior**
- **MRCI & COMPASS --> DII COE "C4I to Sim Services"**
- **Planning Beta release of MRCI**

HLA/C2 Testbed

- Investigate HLA operations/processes
- Evaluate Sim & C4I federation issues
- MRCI - centric issues:
  - Basic concept
  - Extensibility & Portability
  - Functionality
  - Network Performance
  - Scalability
  - Impact on C4I system

MRCI IV&V by NRaD

- **In accordance with DMSO VV&A Recommended Procedures**
- **In coordination with the COMPASS IV&V**
- **Initial efforts in March ‘97**
- **MRCI - “informal release” to NRaD for familization and testing, 20 April1997**
- **“Formal” IV&V this summer**

STOW & JTC

- **STOW Demonstration**
  - **FST 1, 2-6 June 97**
  - **FST 2, 7-11 July 97**
  - **FST 3, 11-15 August 97**
  - **ACTD, 29-30 October 97**
- **Prairie Warrior**
  - **Exercise, 12-20 May 97**

MRCI & COMPASS --> DII COE

- **COMPASS migration underway**
- **MRCI migration being planned**

Beta Release of MRCI

- **Limited release based on exit criteria being developed.**
- **Documentation:**
  - **S/W Design Doc, includes I/F Design Doc**
  - **S/W Version Description**
  - **S/W Users' Manual**
- **In Progress:**
  - **Release policies and procedures.**
  - **Methodology for collecting feedback.**

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Issues Addressed by the MRCI Experiments (1 of 11)

- **Assess the MRCI basic concept: A modular, reconfigurable interface between C4I systems and simulations (via the HLA/RTI) is superior to custom point-to-point interfaces.**
  - **Evaluate the MRCI reconfigurability and reusability from the point of view of software modules used in multiple configurations.**
  - **Evaluate the ease of reconfiguring an MRCI to support a variety of C4I systems, from a hands on point of view, e.g. recompiling required, files to be edited.**

Issues Addressed by the MRCI Experiments (2 of 11)

- **Evaluate the extensibility of the MRCI**
  - **Assess the impact of changing a message mapping on the fly.**
  - **Assess the impact of adding in a new message.**
  - **Assess the tools available to assist in making these changes or additions to the messages.**

Issues Addressed by the MRCI Experiments (3 of 11)

- **Portability**
  - **Inspect code to assess platform/operating system dependencies.**
  - **Assess ease of installing MRCI software in a heterogeneous network.**

Issues Addressed by the MRCI Experiments (4 of 11)

- **Assess MRCI functionality**
  - **Message translation**
    - » **Evaluate the reliability of message translation.**
    - » **Assess the maintenance of message intent by using dual transmissions.**
    - » **Assess the completeness of the message sets translated.**

Issues Addressed by the MRCI Experiments (5 of 11)

- **Application of communications effects**
  - » **Investigate the delay of message communications by variable amounts as a function of battlefield terrain, distance, etc.**
  - » **Investigate the use of varying levels of communications degradation.**
- **Logging**
  - » **Confirm that MRCI logs all relevant FOM and non-FOM messages.**

Issues Addressed by the MRCI Experiments (6 of 11)

- **Scalability**
  - **Assess the performance of multiple translators within one MRCI.**
  - **Assess the performance of multiple nodes of the same C4I system accessing a single MRCI.**
  - **Assess the performance of multiple heterogeneous C4I systems accessing one MRCI.**
  - **Assess the performance of multiple MRCI's in the same federation.**
- **Visibility**
  - **Run multiple echelons with a single MRCI and with multiple MRCI's to assess/illustrate federation visibility.**

Issues Addressed by the MRCI Experiments (7 of 11)

- **Crash, Recovery, C4I System Resynchronization**
  - **Assess the ability of the MRCI prototype to operate during, and recover from, system failures on either its RTI or C4I side.**
  - **Assess future MRCI functionality needed to support resynchronization of the C4I systemwith the federation following degraded operations.**
- **Network Throughput and Delay**
  - **Measure the delay and throughput on the tactical networks.**
  - **Measure the delay and throughput on the simulation networks.**

Issues Addressed by the MRCI Experiments (8 of 11)

- **Hardware**
  - **Measure the MRCI processor requirements as a function of message type and rate as well as the number of C4I systems supported.**
  - **Measure the delay and queueing performance of the MRCI, as a function of load.**
  - **Investigate/evaluate various hardware configurations for the support of the C4I system/MRCI federate.**
    - » **Multiple MRCI's on a single workstation.**
    - » **SSI's hosted on the C4I system and hosted on other workstations.**

Issues Addressed by the MRCI Experiments (9 of 11)

- **Lifecycle of the experiment.**
  - **Evaluate MRCI preparation requirements for experiment participation.**
- **Impact of the MRCI on the C4I system.**
  - **Verify that there is no adverse functional or performance impacts of the MRCI on the C4I system.**

Issues Addressed by the MRCI Experiments (10 of 11)

- **Identify the extent to which adding real-world C4I aspects to an HLA Federation levies requirements on simulations in that federation.**
  - **Scenario development**
  - **Message processing**
  - **Inclusion of C2 behaviors**
  - **Performance impact**

Issues Addressed by the MRCI Experiments (11 of 11)

- **Assess the adequacy of the C2 data interchange format (DIF) (e.g. CCSIL)**
  - **Assess the ability of CCSIL to express all of the required C4I message fields.**
- **Address the issue of the initialization, synchronization, and reconciliation of data between the C4I systems and the simulations.**

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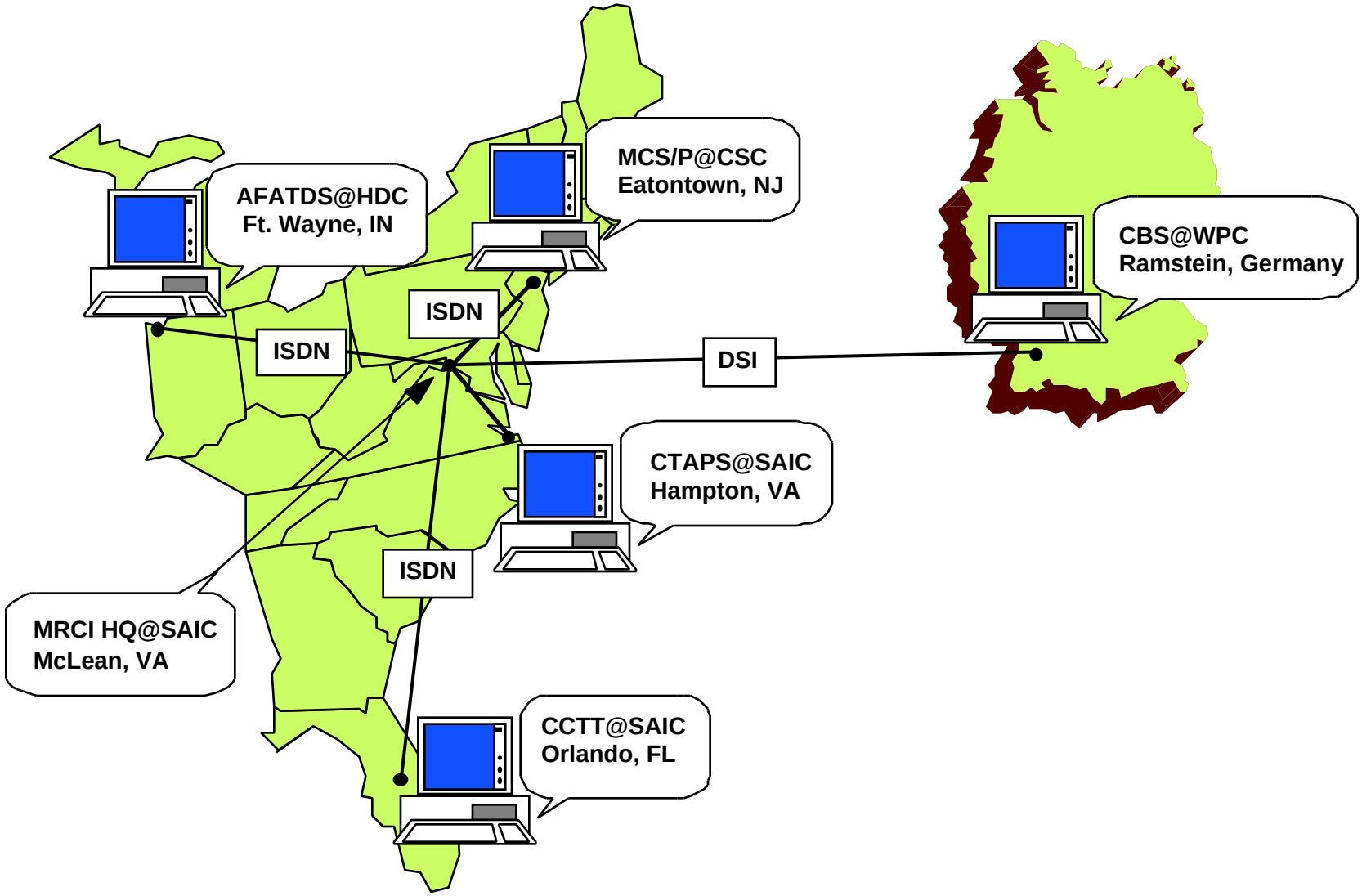
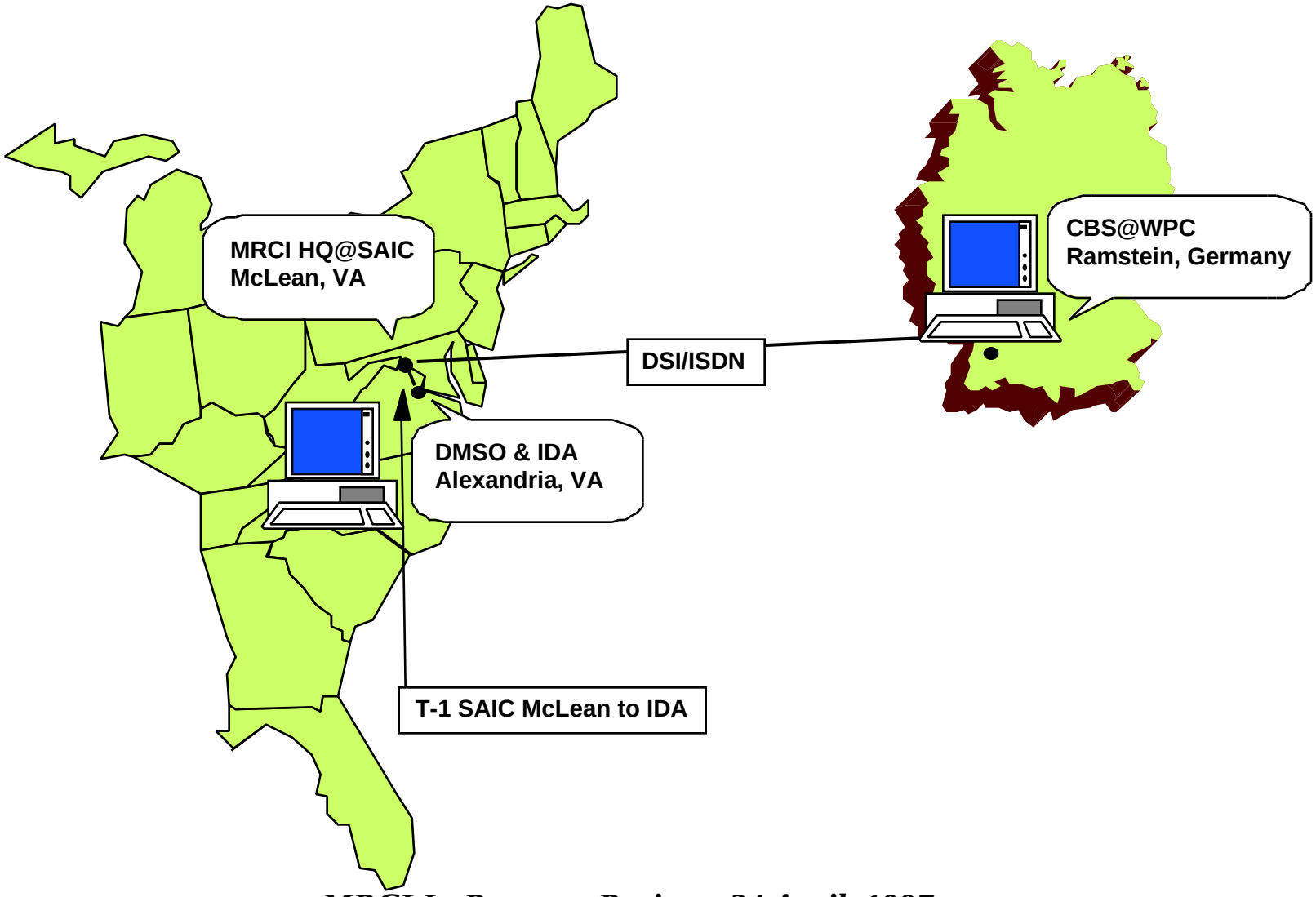
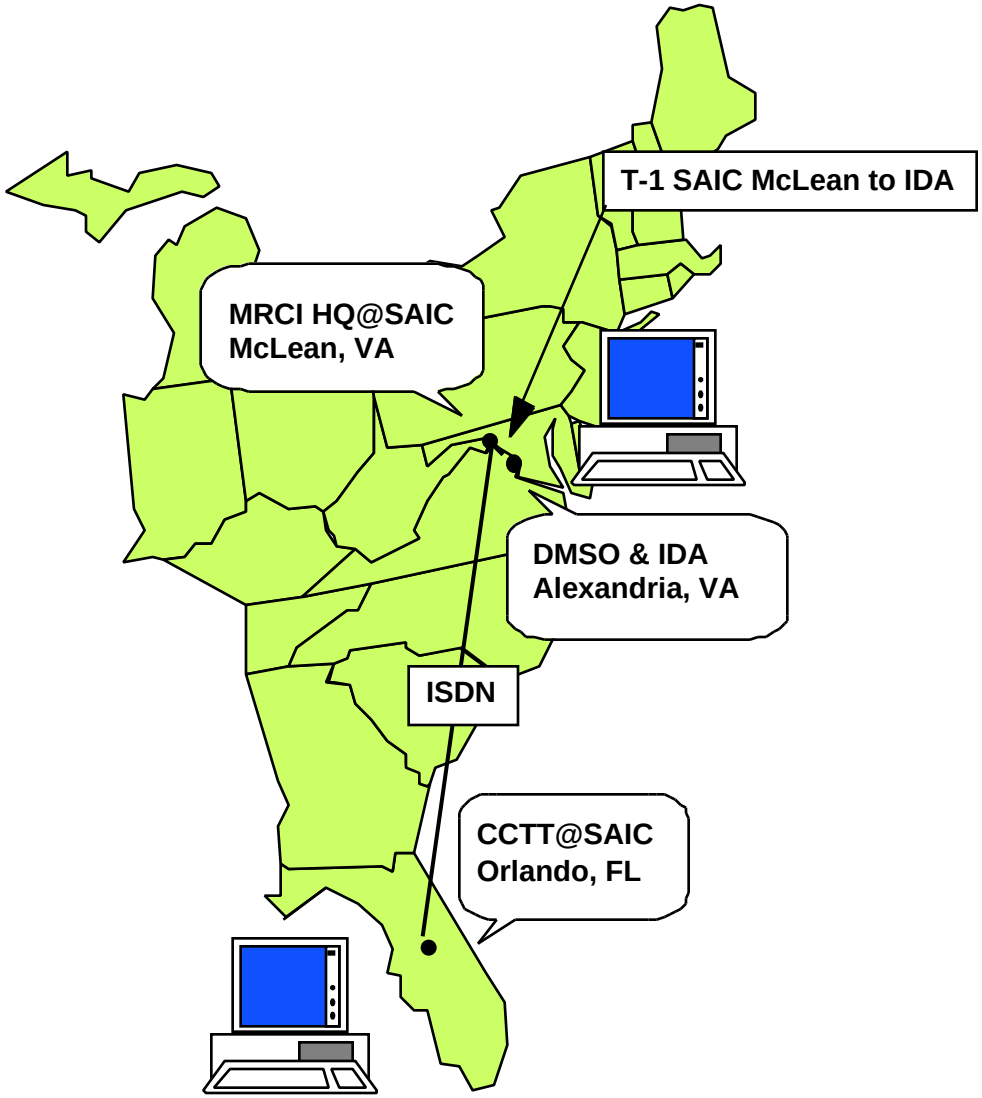
MRCI Distributed Development and Test Environment



Configuration for IPR
IDA to WPC in Germany



Configuration for IPR
IDA to SAIC in Orlando



Federates in IPR Experimental Tests

MCS/P to ARSAF

MCS/P to CBS

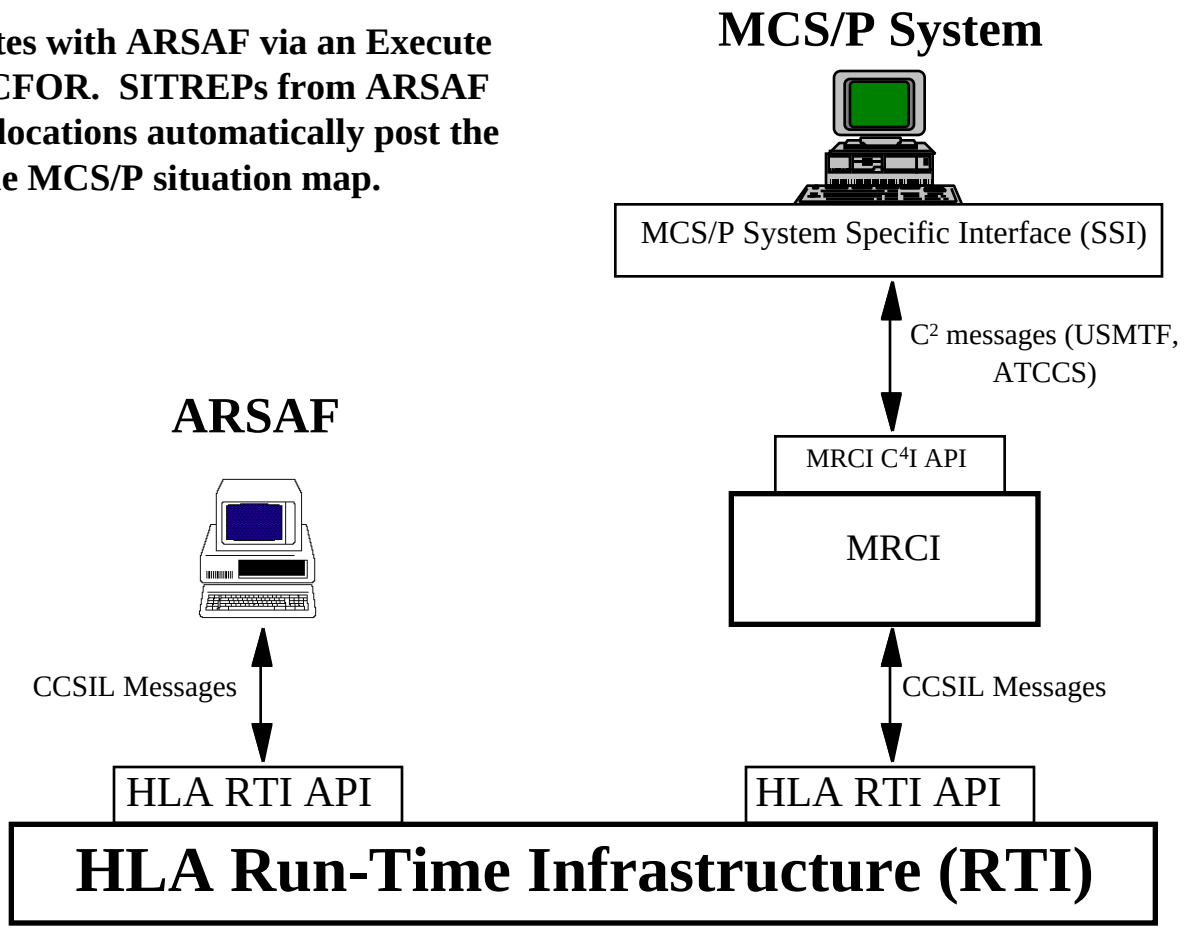
MCS/P to CCTT SAF

AFATDS to Test Cell

CTAPS to Test Cell

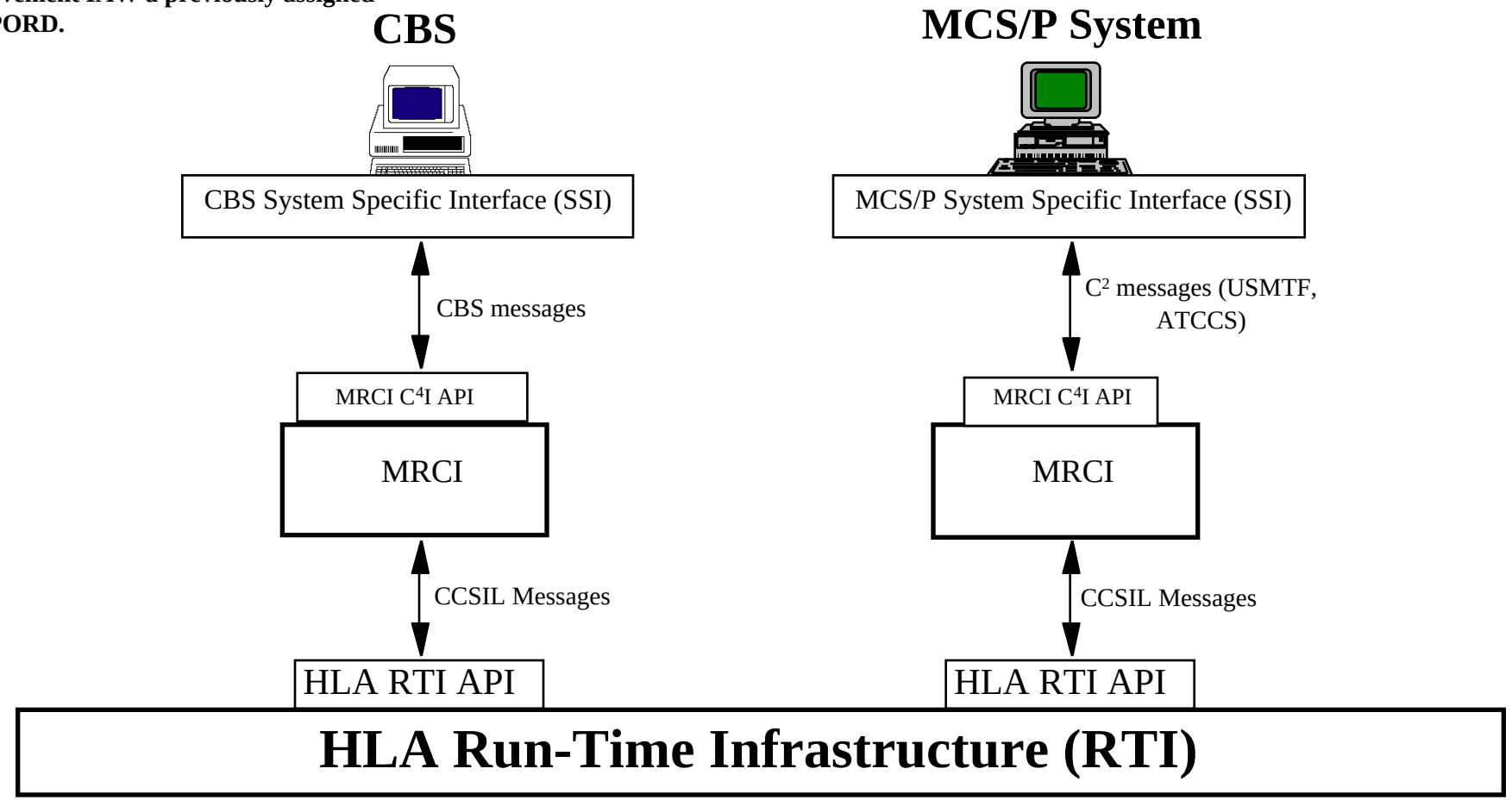
MCS/P to ARSAF
Experiment Configuration

MCS/P communicates with ARSAF via an Execute Directive issued to CFOR. SITREPs from ARSAF containing friendly locations automatically post the unit's location on the MCS/P situation map.



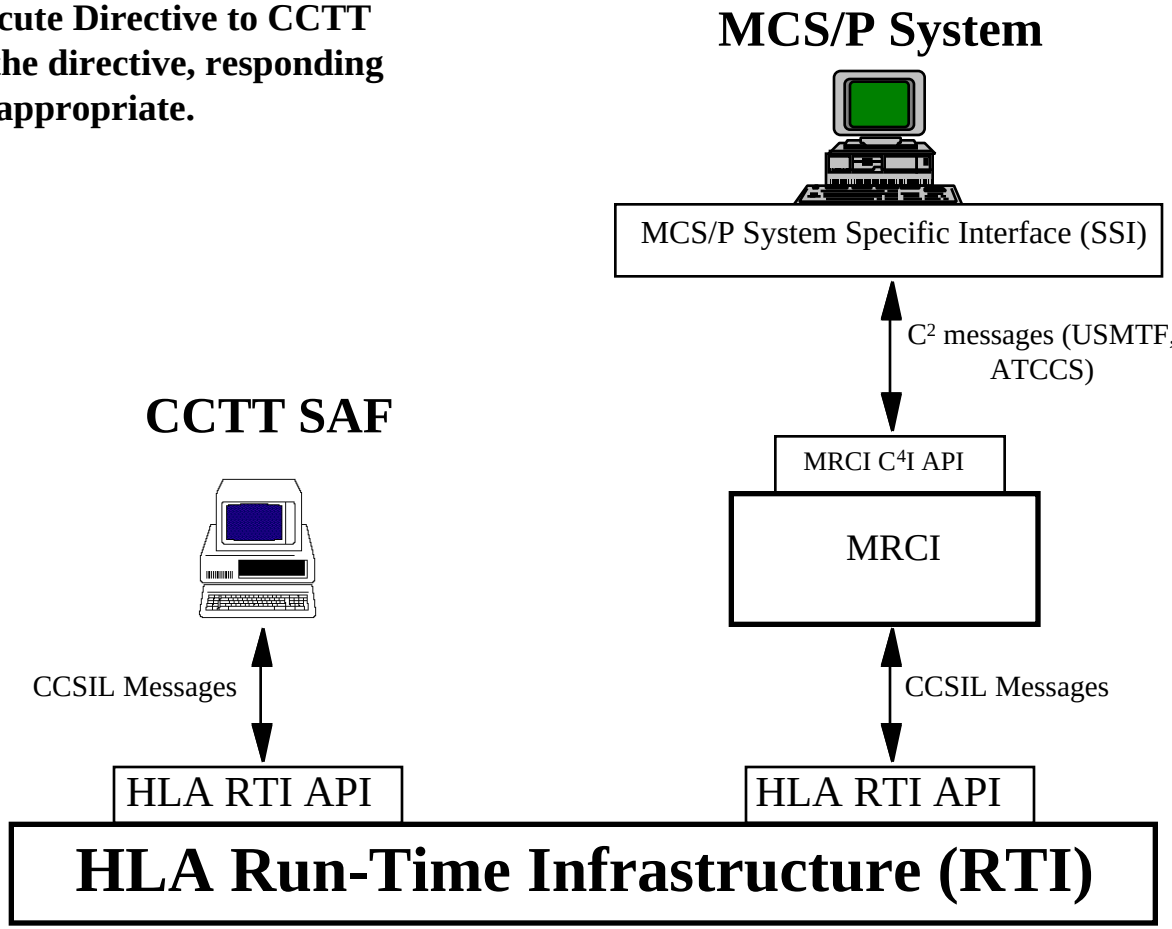
MCS/P to CBS
Experiment Configuration

MCS/P sends an Execute Directive to CBS causing the CBS battalion to begin movement IAW a previously assigned OPORD.



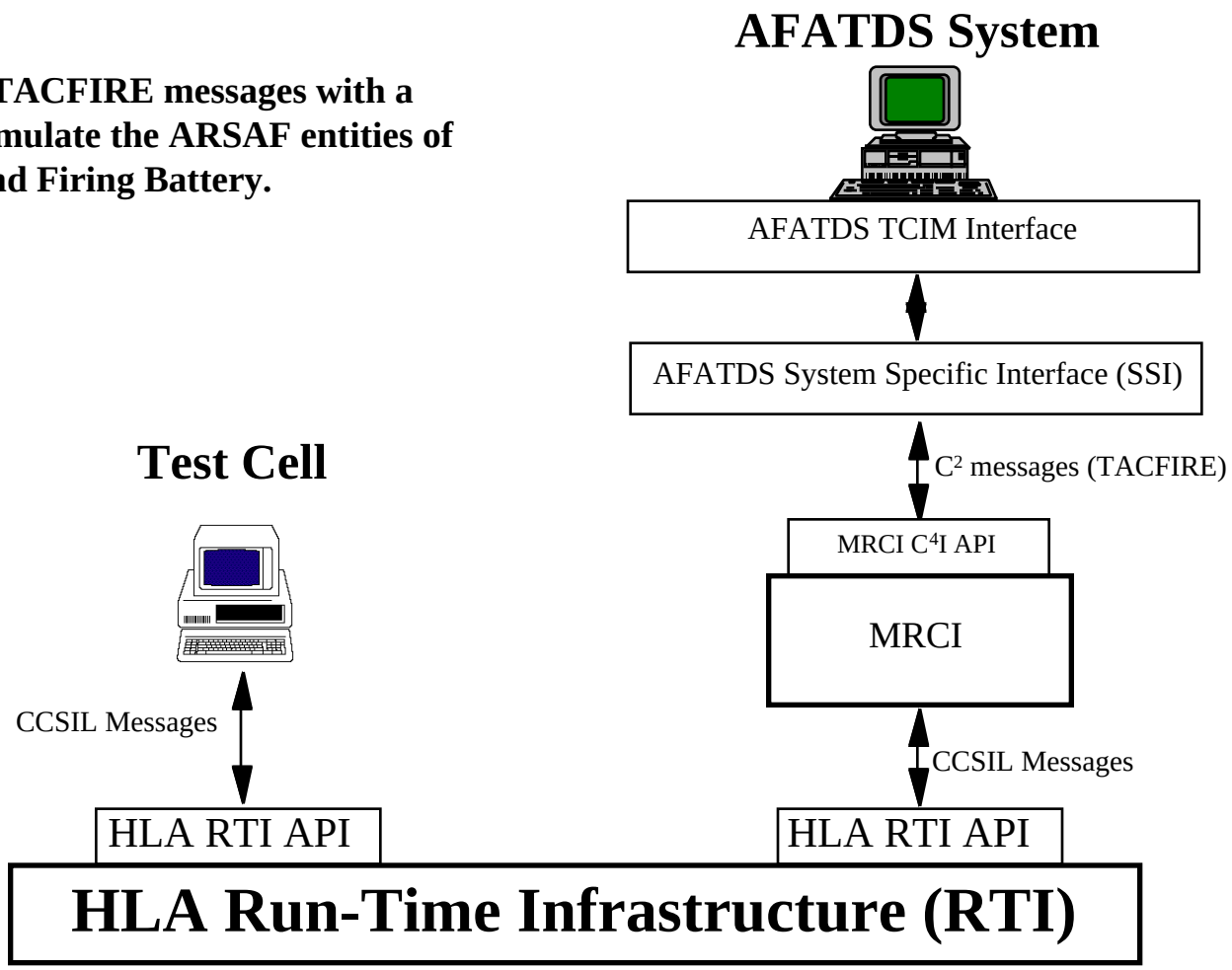
MCS/P to CCTT SAF
Experiment Configuration

MCS/P issues an Execute Directive to CCTT SAF which executes the directive, responding with SITREPs when appropriate.



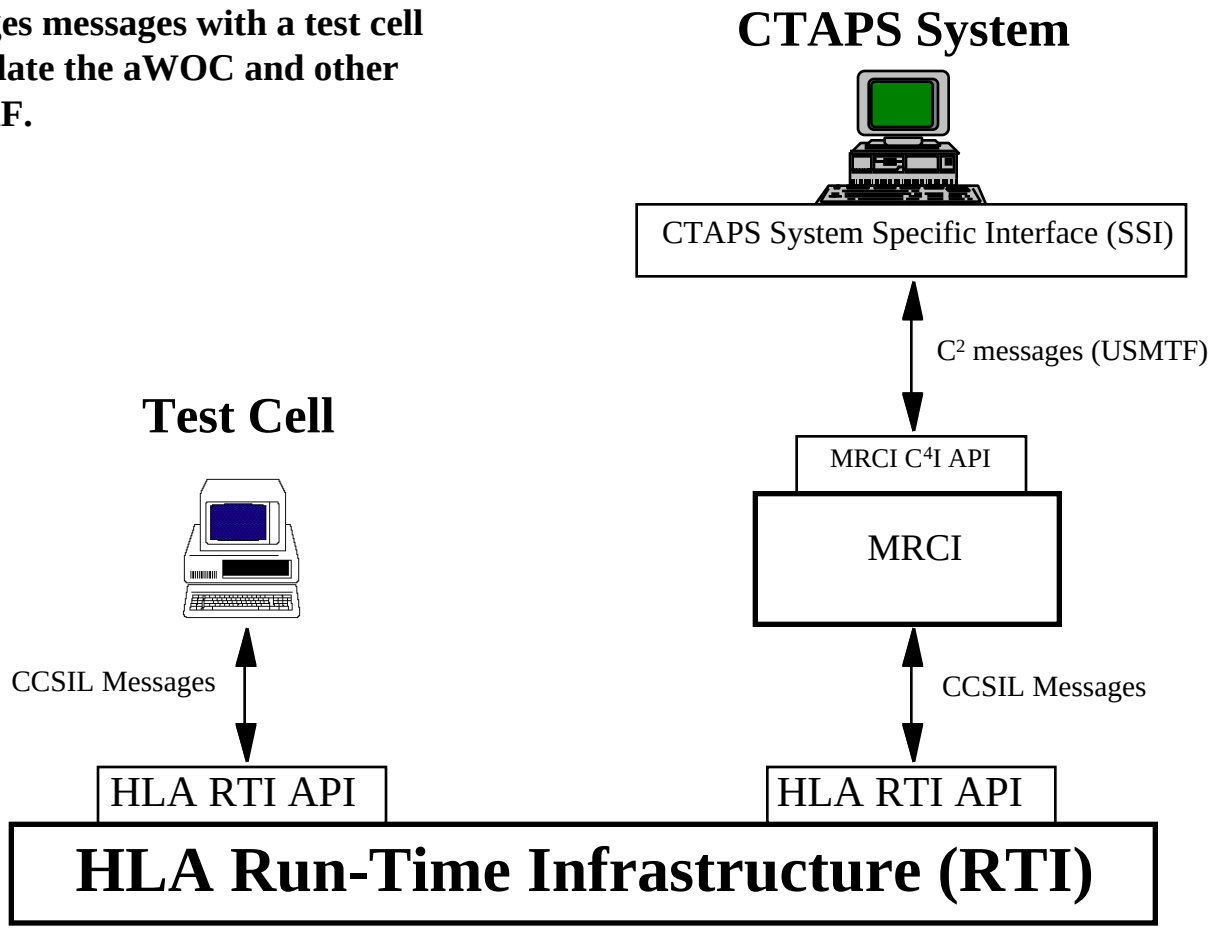
AFATDS
Experiment Configuration

AFATDS exchanges TACFIRE messages with a test cell designed to emulate the ARSAF entities of Forward Observer and Firing Battery.

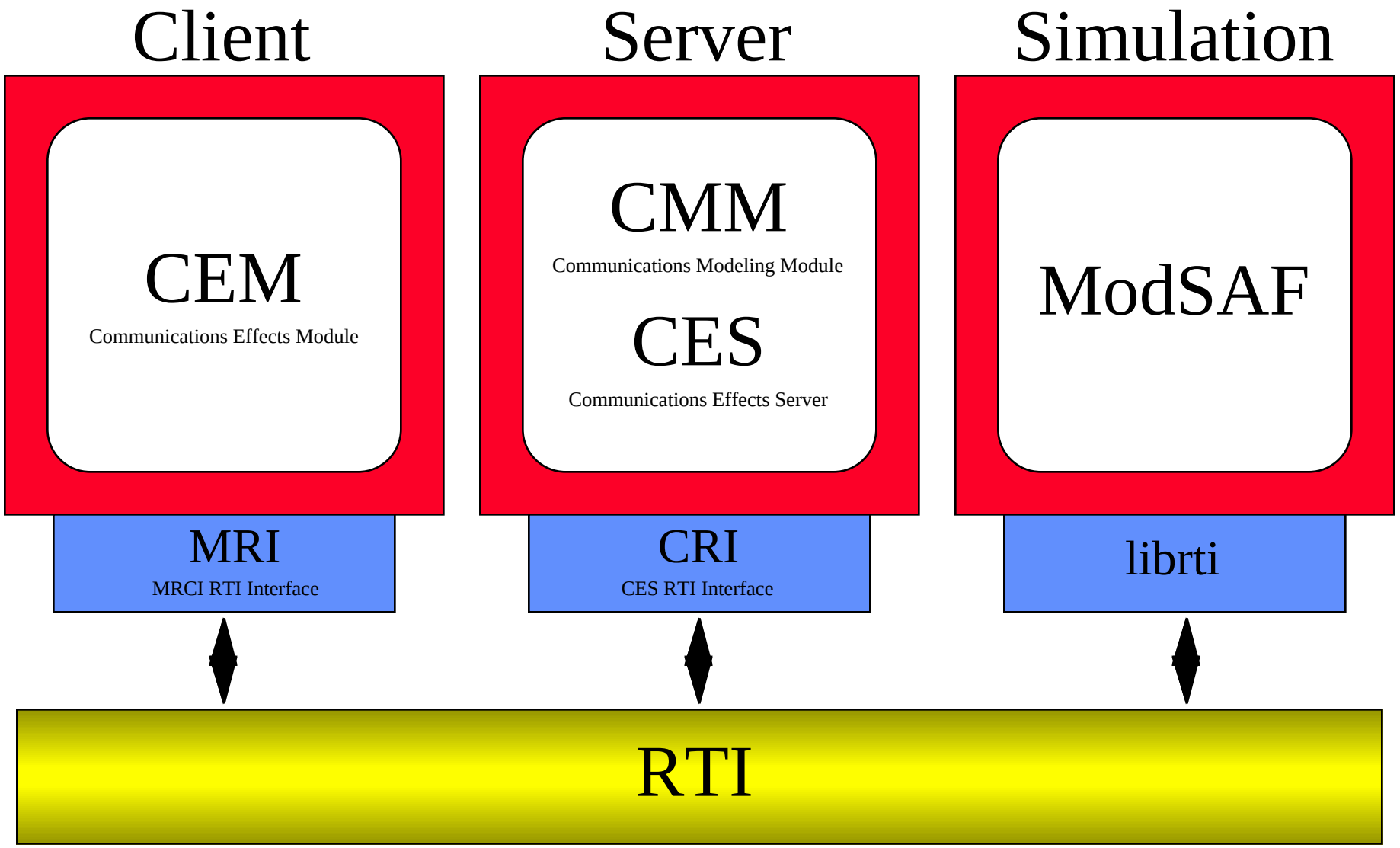


CTAPS
Experiment Configuration

CTAPS exchanges messages with a test cell designed to emulate the aWOC and other entities in AFSAF.



ACESS IPR Demonstration Configuration



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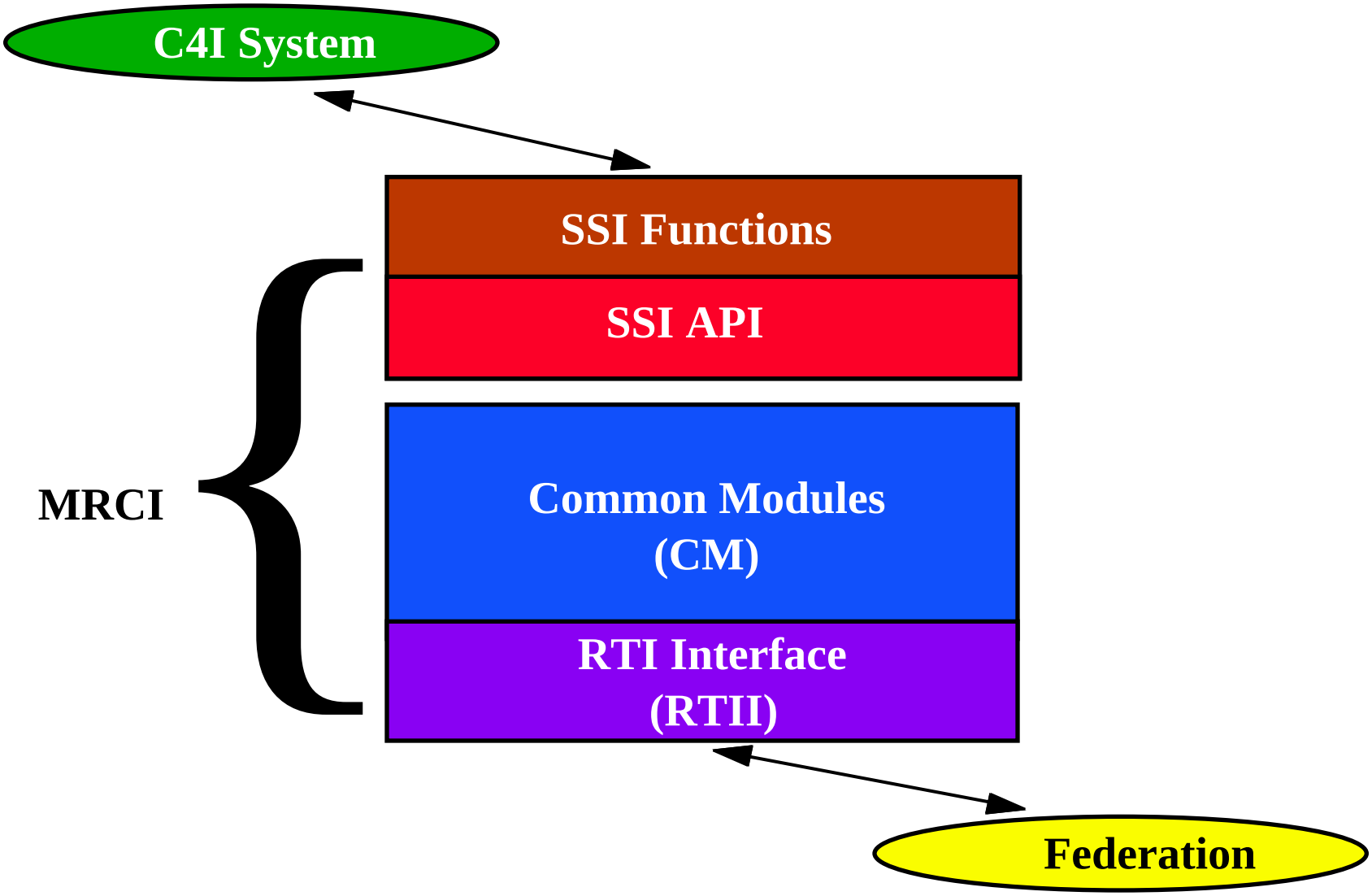
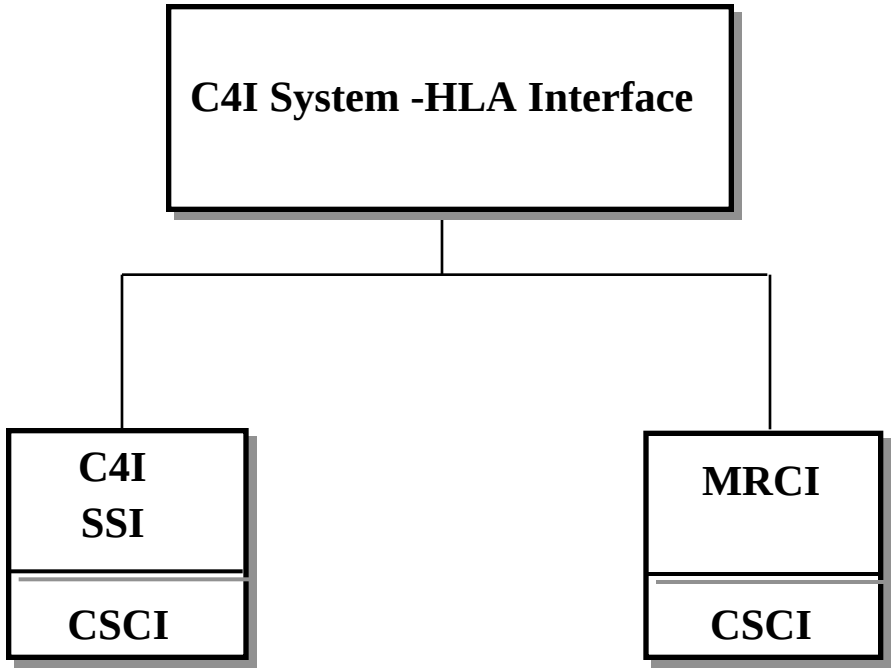
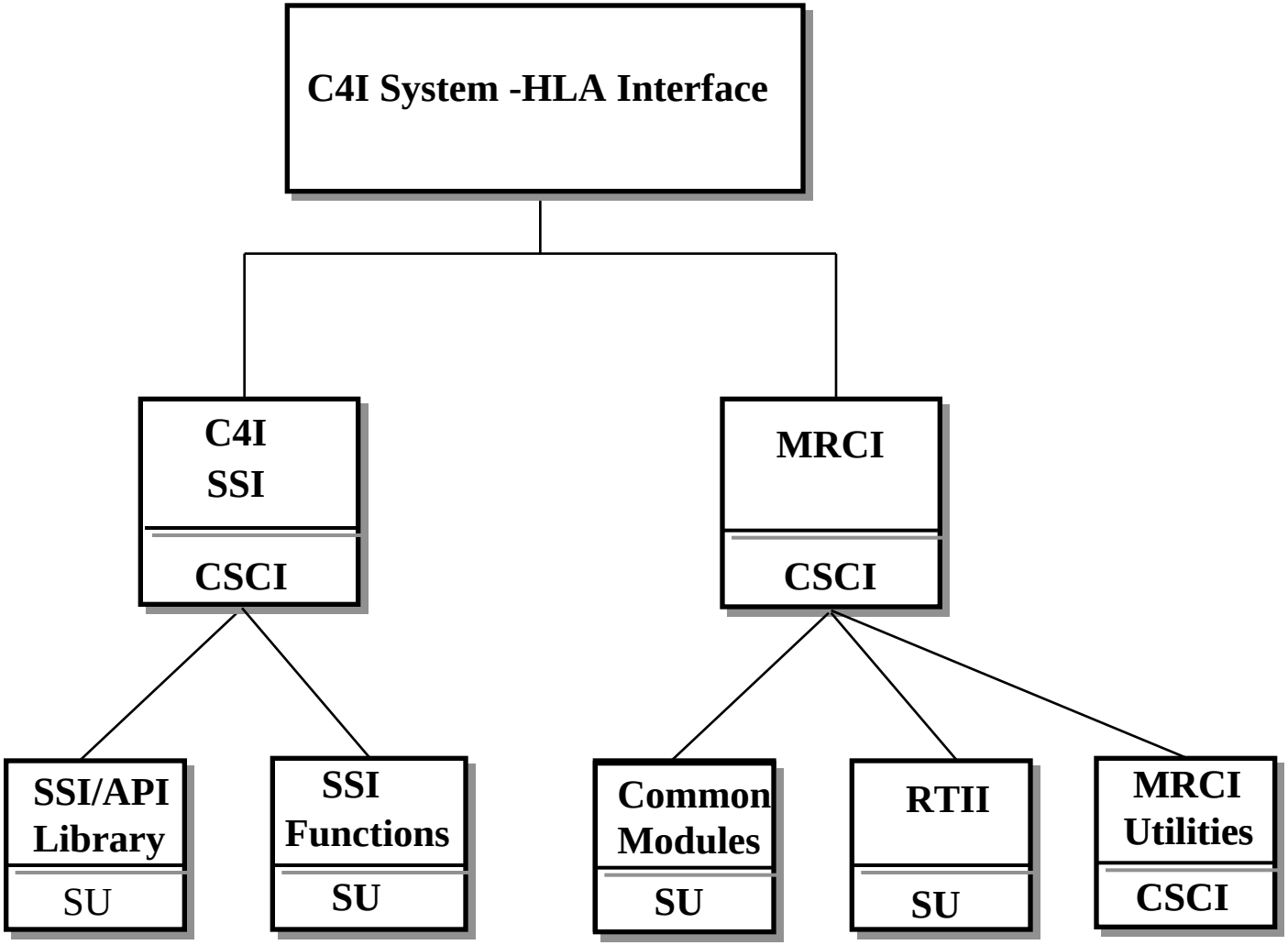
MRCI Technical Architecture



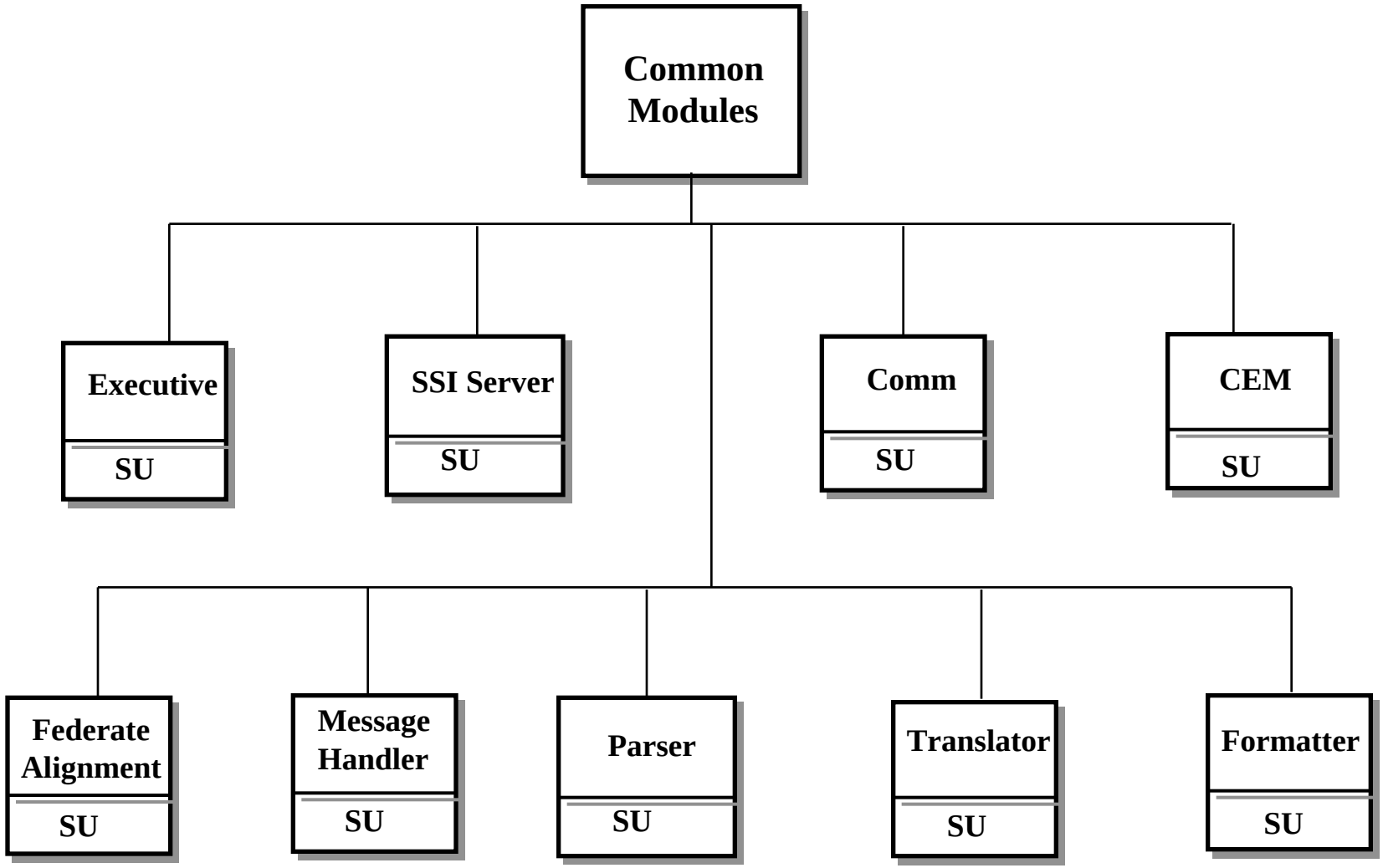
MRCI Modules – CSCIs



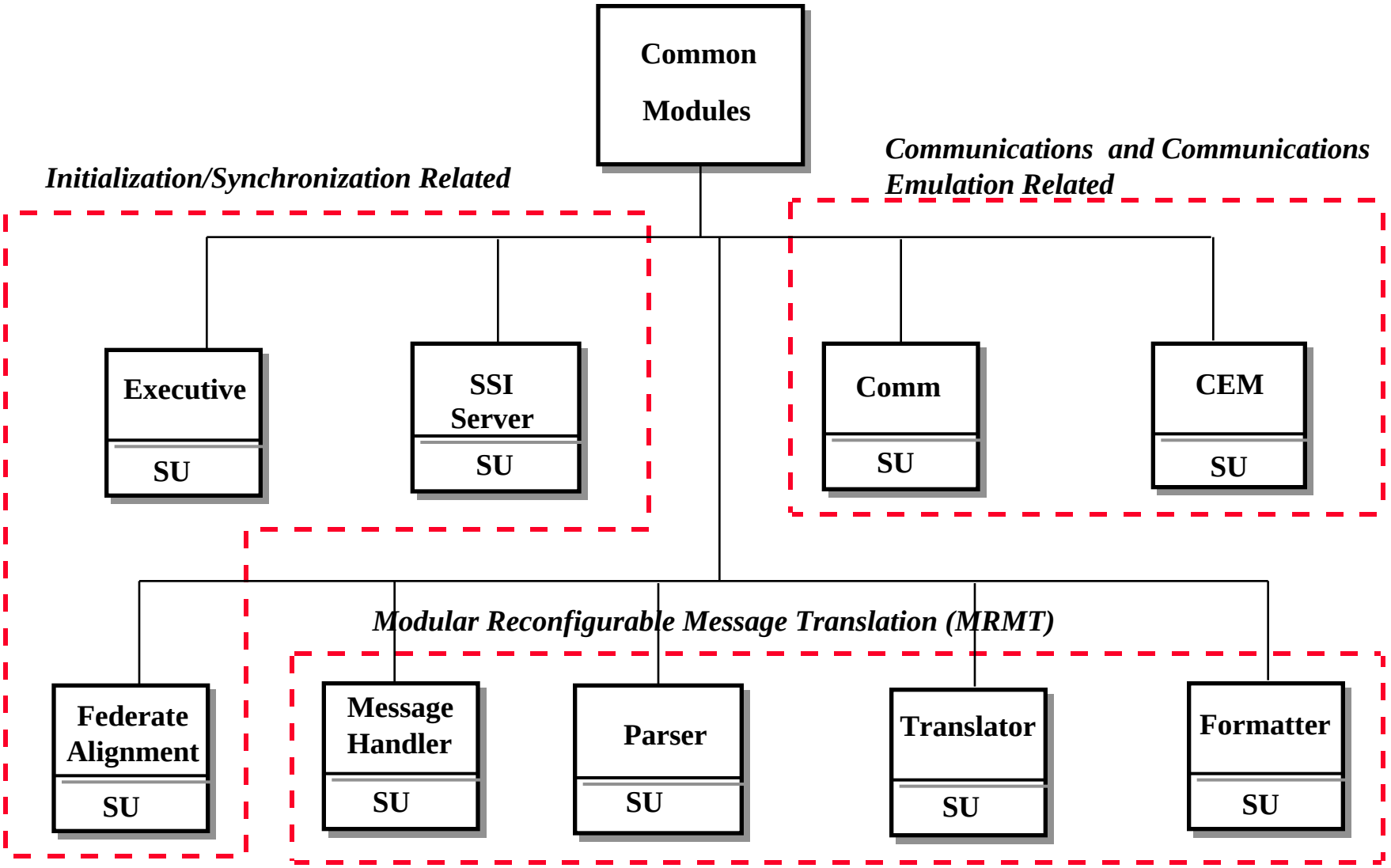
MRCI Modules – SUs



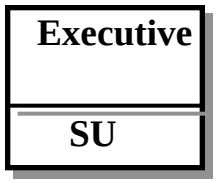
MRCI Common Module SUs



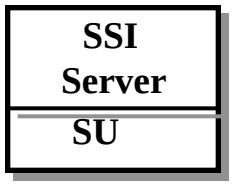
MRCI Common Module SU Groupings



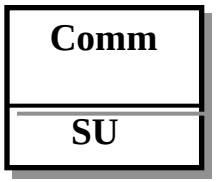
MRCI Common Module Descriptions



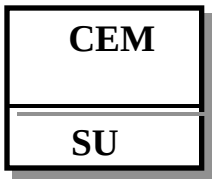
- Calls all other modules
- GUI



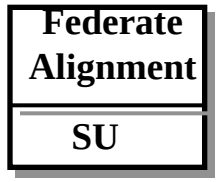
Connects to SSI
- Registration
- Message passing
- Comm parameters
- DB connection
- Status



Comm Representation

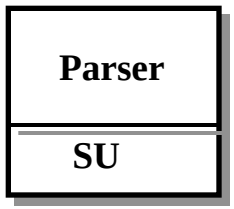


Communication Effects Module applies effects calculated by a Comm Effects Server

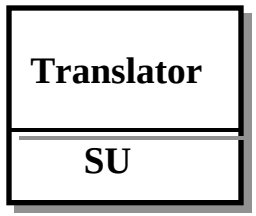


- Dynamically aligns live and simulated entities from Federates (such as Order of Battle)
- Aligns entity attribute (e.g. Comms)

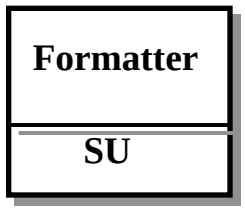
Receives message from RTII
- Parses Message Header
- Passes Comm Parameters (receivers, sender)
- Determines message type



Parses message into Universal Structure

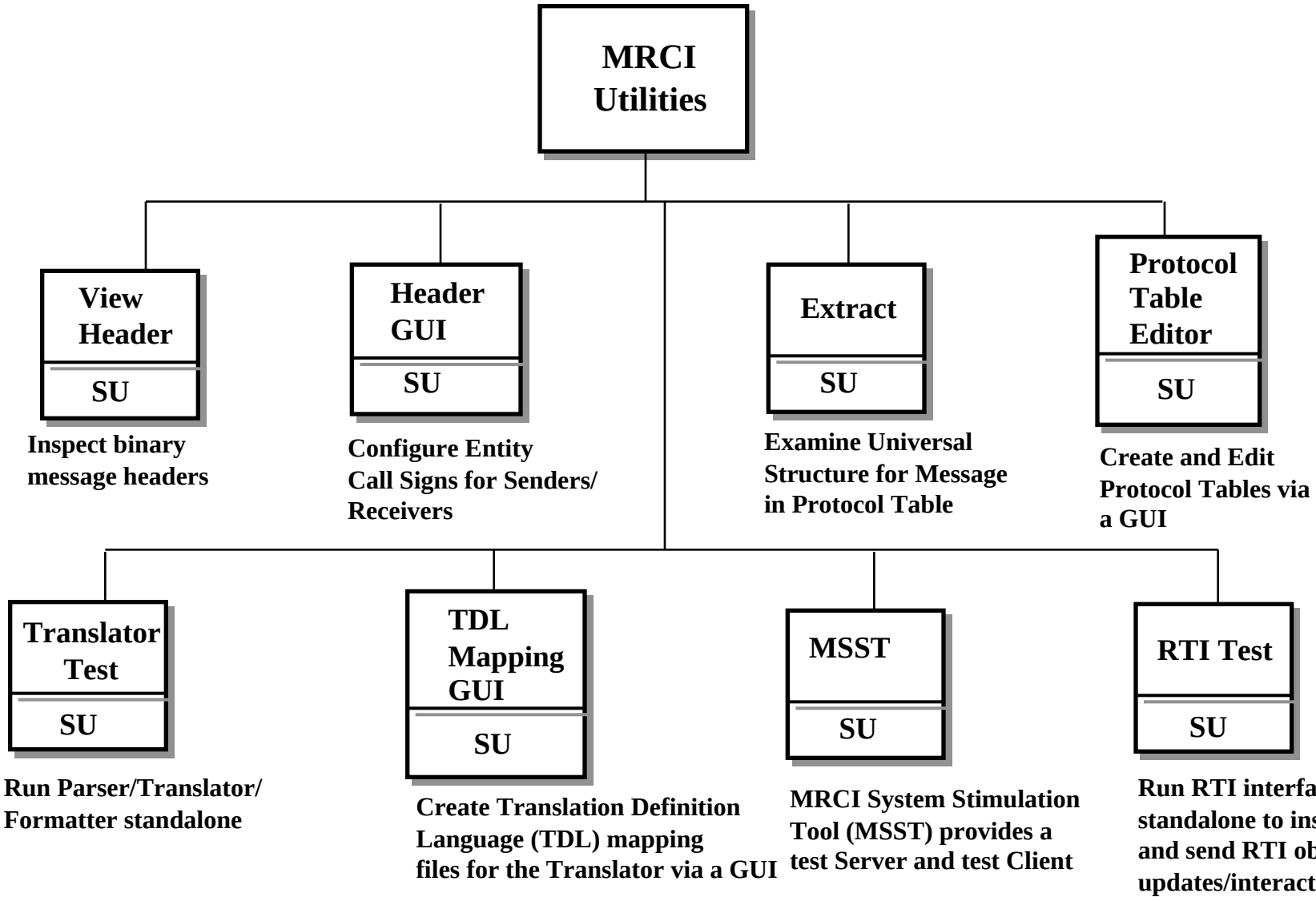


File-driven translation



Formats message from Universal Structure

MRCI Utility Module Descriptions



Translator Common Modules
Modular Reconfigurable Message Translation (MRMT)

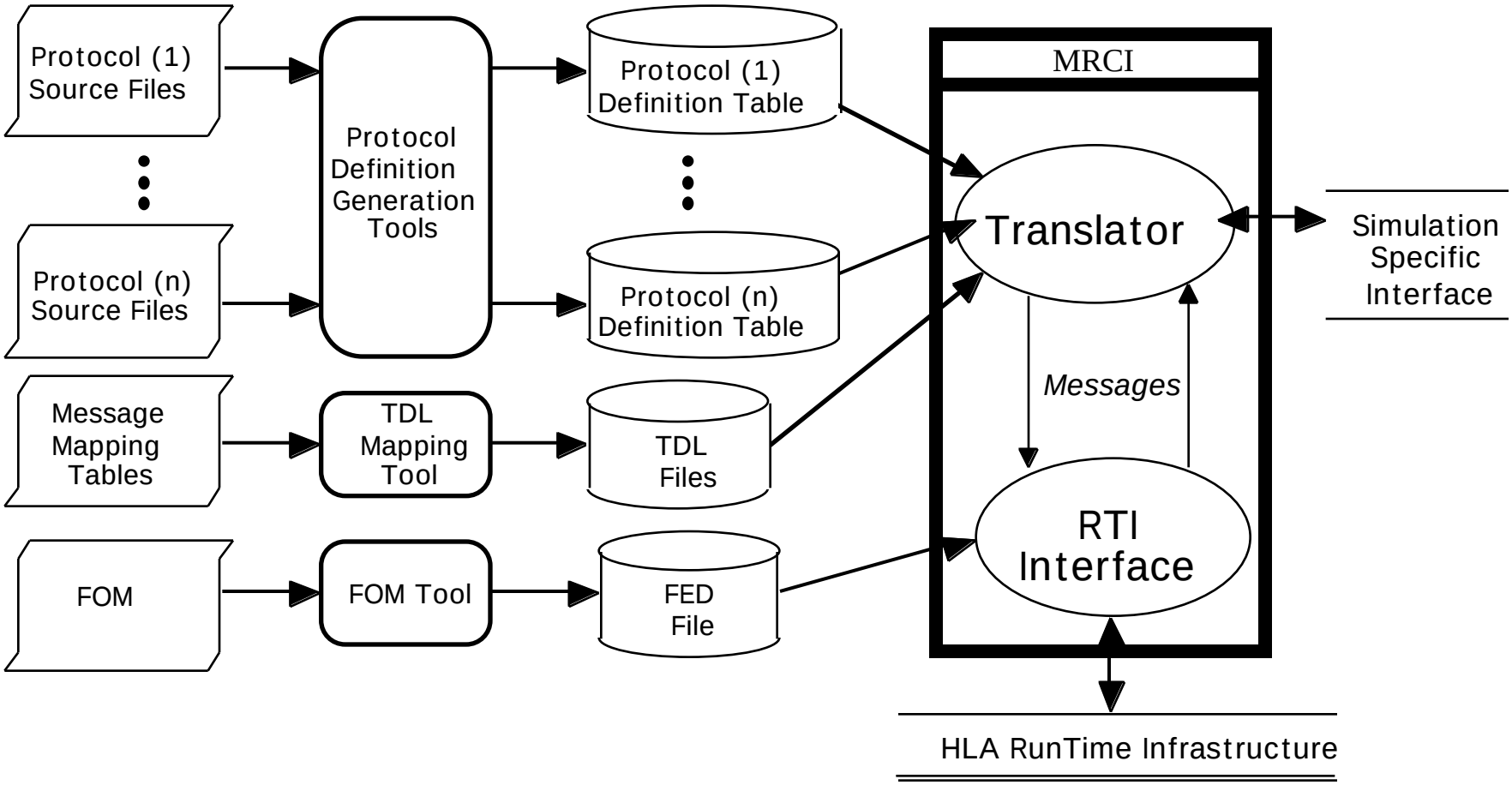
- MRMT takes a lifecycle approach with a flexible design to accommodate the addition of new message formats and the revision of currently utilized message formats.
- MRMT has three phases of preparation and use
  - Protocol Preparation

    Protocol Table generation routines and Parser modules are customized for a new message format.
  - Exercise Preparation

    Mapping Tables specifying the mapping of C4I to Simulation Messages are created by System Analysts for the particular messages utilized in the exercise. Translator Definition Language (TDL) files are prepared from the Mapping Table.
  - Initialization

    Message Structures are created from the Protocol Tables and Translation Objects are created from TDL files.

Modular Reconfigurable Message Translation (MRMT)



MRMT Uniform Message Structure

- Protocol tables have data structures for messages, fields and enumerations
- An abstract description of the structures is:

Message_rec:

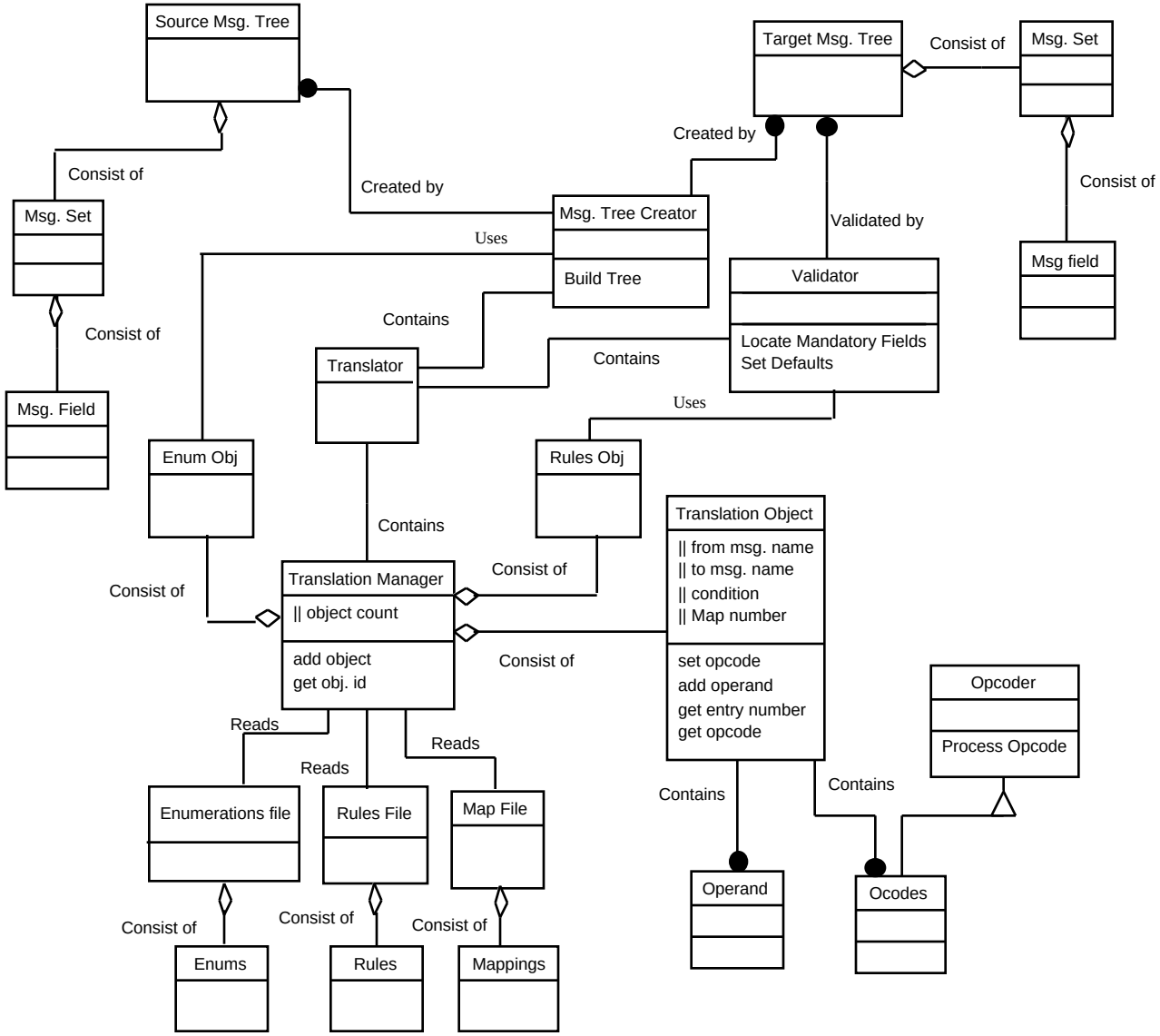
name,
msg id,
prefix,
suffix

Field_rec:

label,
conditional flag,
data justification,
sequence number,
byte offset,
min size,
max size

description
data type
msg data
new data flag
min value
max value

Translator Design and Internal Interfaces



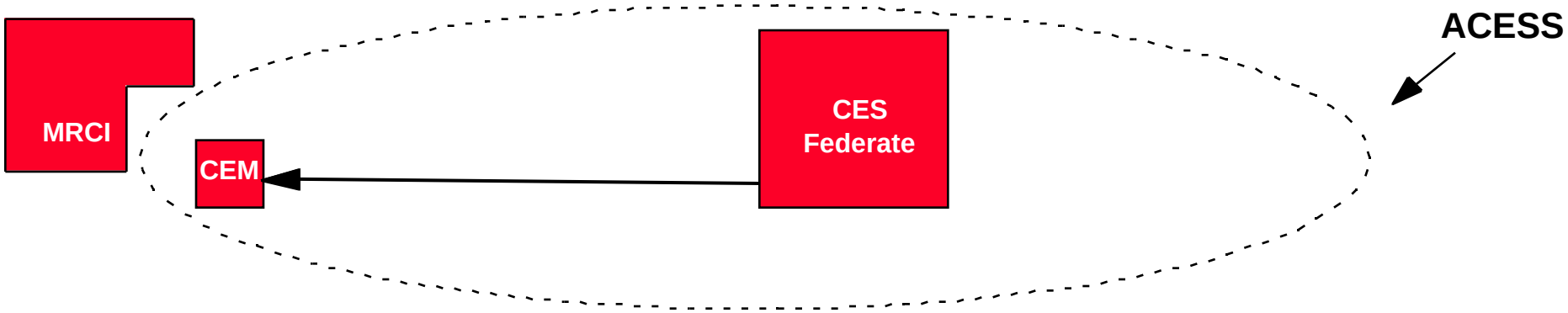
ACESS Defined

The Automated Communications Effects Server System (ACESS) is a modular server system that is proposed to be used to apply tactical communications effects in a simulated environment. The ACESS operates within High Level Architecture (HLA) guidelines as defined by the Defense Modeling and Simulation Organization (DMSO).

The ACESS is composed of two parts:

1) The Communications Effects Module (CEM)- A module incorporated within a system acting as a federate in an HLA exercise
2) The Communications Effects Server (CES)- A stand alone system acting as a federate in an HLA exercise

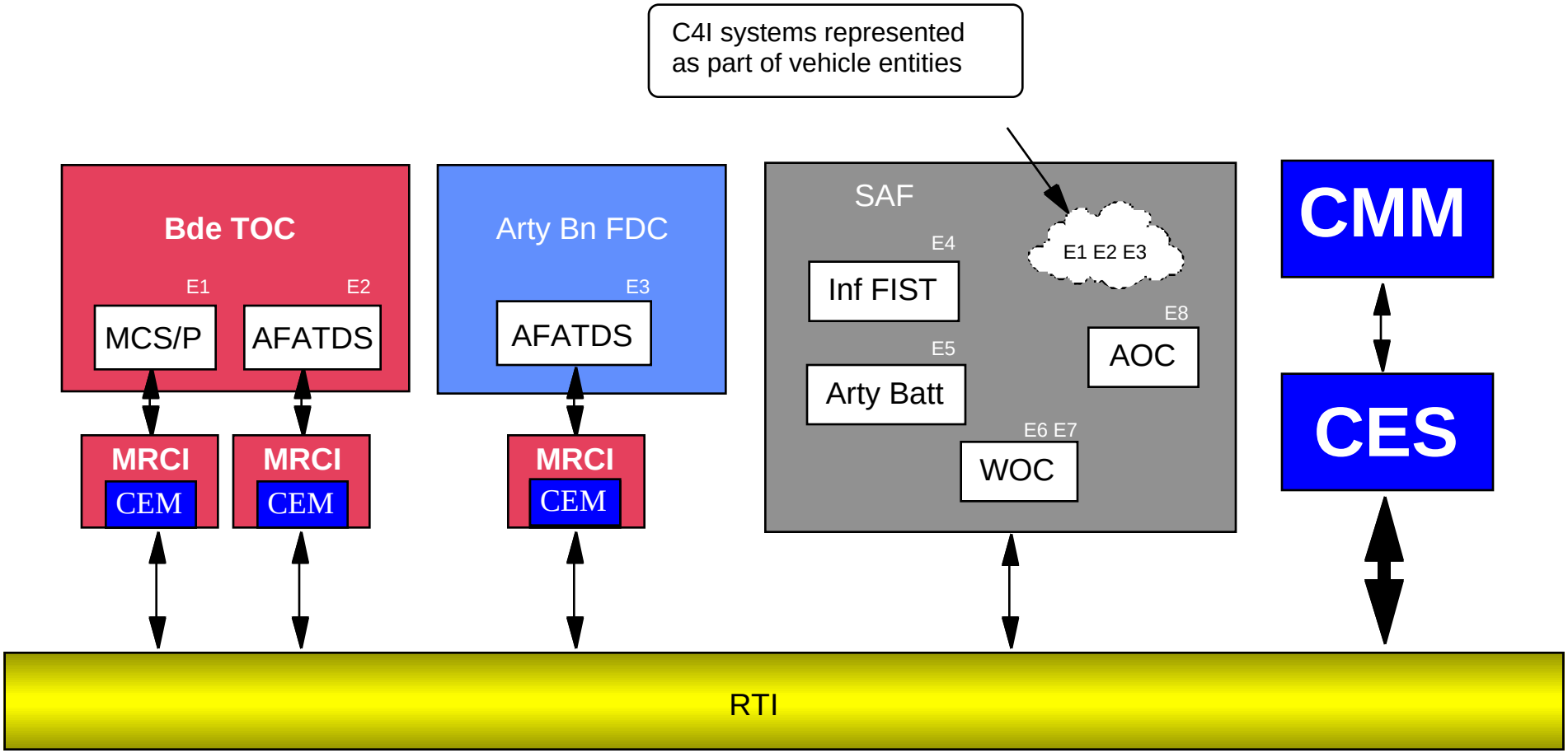
- Both components will communicate via the HLA Run Time Infrastructure (RTI).
- The Modular Reconfigurable C4I Interface (MRCI) will be the first system to integrate the ACESS.



The CEM determines message delivery based on:
- communications object settings
  OR
- degradation parameters received from the CES

The CES:
- monitors aspects related to communications
  AND
- generates degradation parameters on a per message basis

Representative ACESS Experimental Configuration



The Three Key Representational Levels Within the ACESS

Static without degradation

Communications Object

Level 1

Purpose:
- Adequately represents communications device
- Facilitates dissemination of changes in attributes

Used by:
- CES as communications determinant
- CEMs as most basic communications determinant

Maintained and updated by:
- Creating federate upon initialization and attribute changes

Dynamic periodic

Maximum Communication Effects Matrix Interaction

Level 2

Purpose:
- Sender/receiver pairs identify dynamic communication effects parameter values to apply to messages in the absence of a Communications Effects Interaction
- Backup for Communications Effects Interaction

Used by:
- CEM as initial message release determinant

Generated and sent by:
- CES upon initialization and when significant change in state occurs

Dynamic per message

Communication Effects Interaction

Level 3

Purpose:
- Contains value that accurately represents simulated time of message delivery and all modeled communications parameters such as Bit Error Rate, dB Loss, etc..
- Determines when CEM releases message
- Provides values of degradation parameters

Used by:
- CEM to accurately determine message release time and degradation

Generated and sent by:
- CES upon receipt of message

Future ACESS Prototypes

- **Integration of STOW RTI-C/C1, RTI F.0/F.1**
- **Continued participation in HLA efforts to optimize infomation placement**
- **Completion of Communications Effects Matrix functionality to provide static state of the network information**
- **CES interoperability with other Sims (AFSAF, NASM-AP, EAGLE, etc…)**
- **Investigate "token based" voice/video communication emulation**
- **Investigate query based communication effects calculations for units attempting to intercept signals**
- **Investigate application of ACESS effects within SAFs**
- **Continued MITRE CMM prototype development to include expended communications effects such as BER and retransmissions**

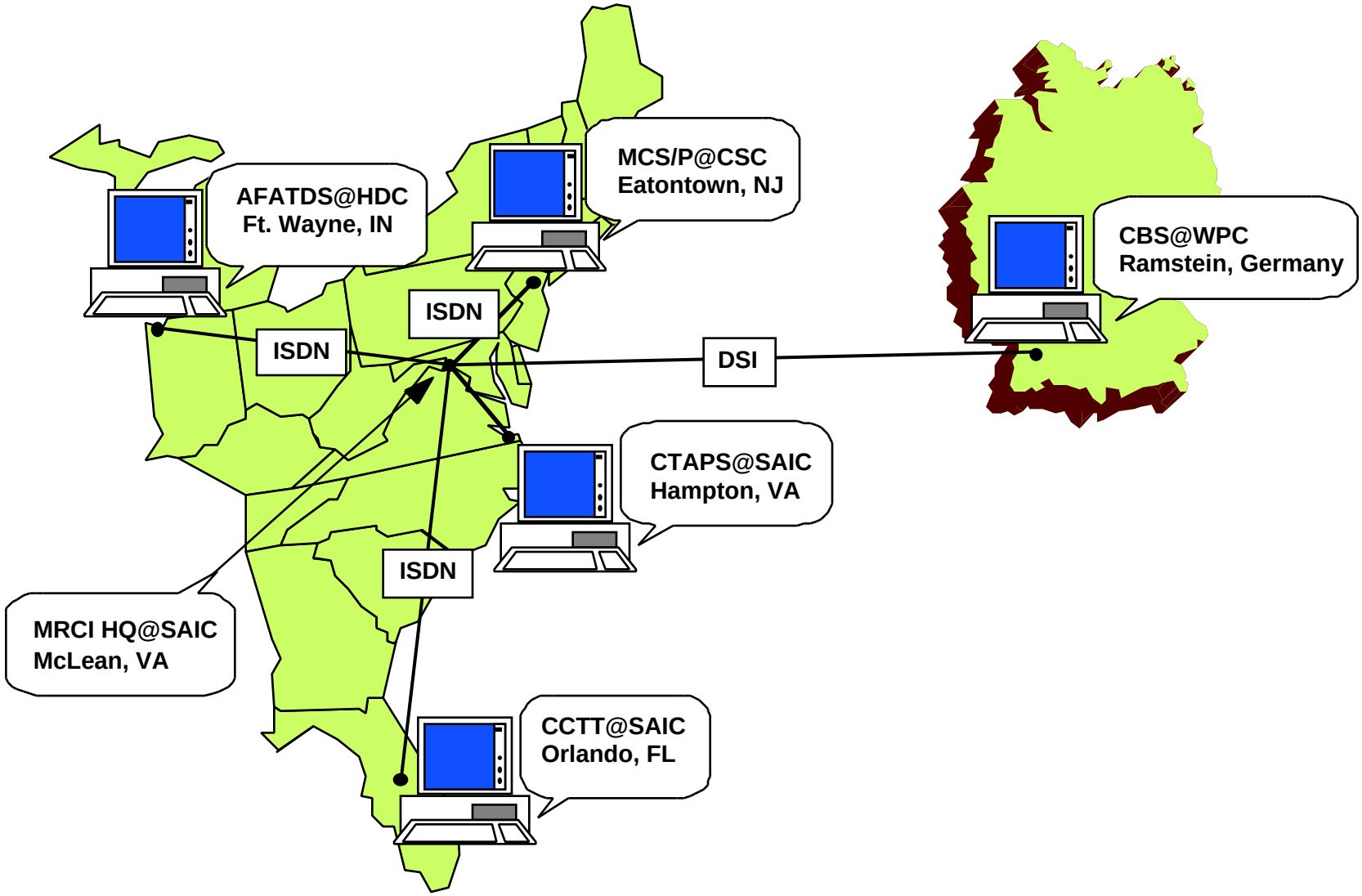
AGENDA (1 of 4)

0830-0845	**Welcome, Introduction, and Recent Activity Summary**	**Maj. Zeswitz C. Keune M. Cosby**
0845-0915	**Issues addressed by the MRCI Experiments**	**C. Keune M. Cosby**
0915-0935	**Experimental Test Federation Configurations**	**M. Cosby**
0935-1020	**Prototype MRCI Design Summary Overall Design Module Architecture Translation Design Communication Degradation Design**	**M. Hieb/K. Thumim/B. Silva**
1020-1035	**Prototype MRCI Implementation and Development Approach Summary**	**L. Griggs**
1035-1050	**Break**	

Development Approach Summary

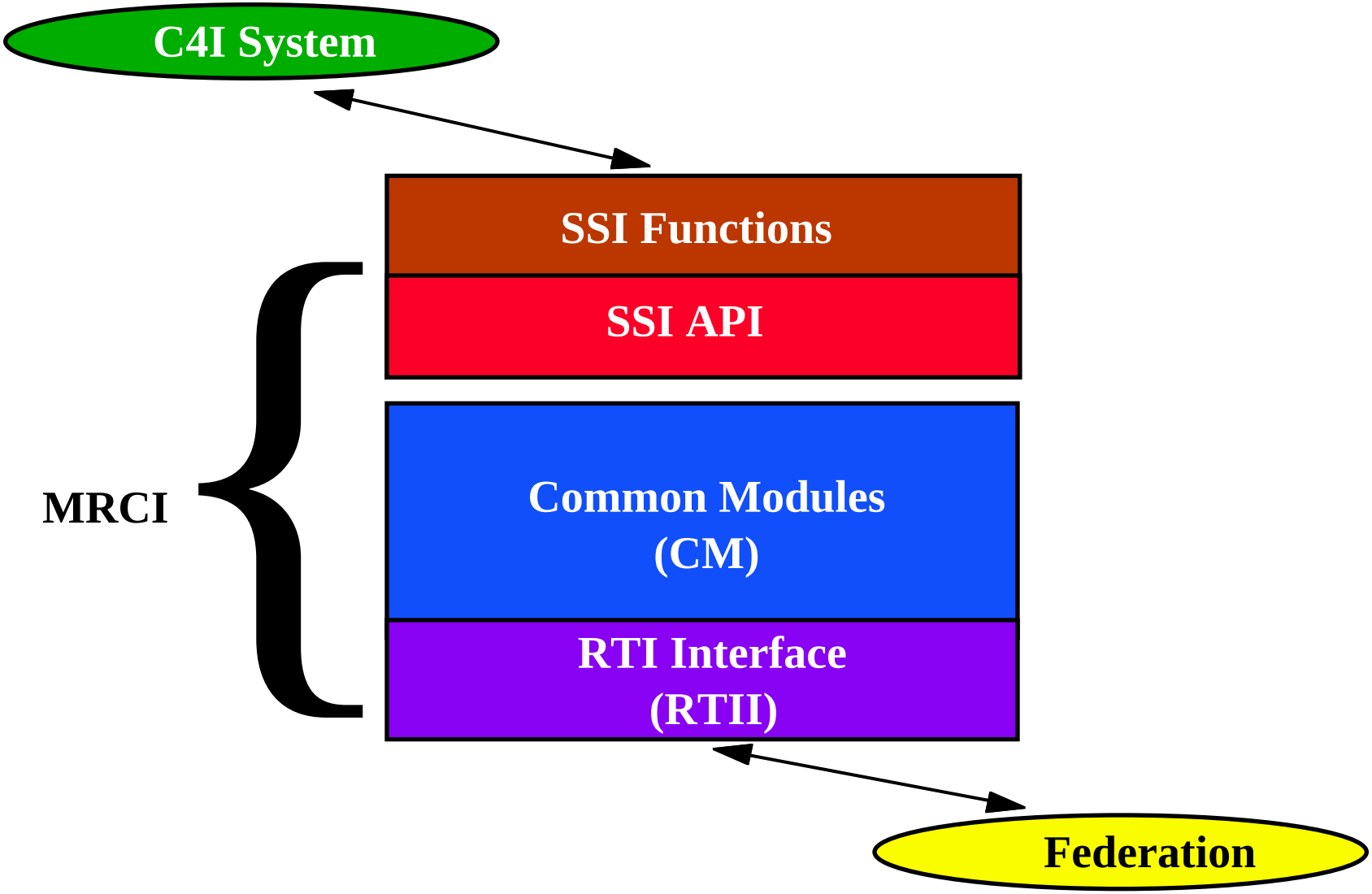
Version <.> Build	SSIs	RTI Versions	Simulation Federations	New MRCI Common Modules	Remarks
1.1	MCS/P (BL) CTAPS	STOW A	STOW 97	- Executive (mex) - Translator (mct) - Message Handler (mcm) - RTI Interface (mri) - MRCI C4I Server (mss) - MRCI C4I Client Libraries (msc)	· MCS/P SSI receive (dequeue)only · CTAPS SSI was transmit (enqueue) only · Translator handled USMTF SITREP & CCSIL SITREP · Evaluation Events: -STOW 97 Combined Test 4 (Dec 96)
1.2	MCS/P (BL) CTAPS AFATDS	STOW A	STOW 97 JTC	- Communications (mcc)	· Translator module adds ATCCS capability · Evaluation Events - JTC Confederation Test (CT) 97 (Mar 97)
1.3	MCS/P (BL) CTAPS AFATDS	STOW A	STOW 97 JTC	GUI (xapps)	· Translator module will add TACFIRE capability · Evaluation Events - STOW 97 SEID Integration Test (Apr 97) - JTC Prairie Warrior 97 (May 97)
1.4 (and later)	MCS/P (BL) CTAPS AFATDS	F.0 STOW C	HLA-C2 STOW 97 JTC		· Evaluation Events - HLA C2 Test bed (Aug 97) - STOW 97 FST-x (June, July, Aug 97)

MRCI Distributed Development and Test Environment



Prototype MRCI (V1.3) Implementation (1 of 4)

MRCI Technical Architecture



AGENDA (1 of 4)

0830-0845	**Welcome, Introduction, and Recent Activity Summary**	**Maj. Zeswitz C. Keune M. Cosby**
0845-0915	**Issues addressed by the MRCI Experiments**	**C. Keune M. Cosby**
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1020-1035	**Prototype MRCI Implementation and Development Approach Summary**	**L. Griggs**
1035-1050	**Break**	

AGENDA (2 of 4)

1050-1200	**Prototype MRCI (V1.3) Development Status**	**L. Griggs/M. Hieb**
	C4I System Capabilities (including SOMs)	**B. Silva**
	-AFATDS	
	-MCS/P Baseline	
	-CTAPS	
	Simulation Capabilities	
	-CBS	
	-AFSAF	
	-ARSAF	
	-CCTT	
	ACESS Development	
	Testing Program	
1200-1300	**Lunch**	

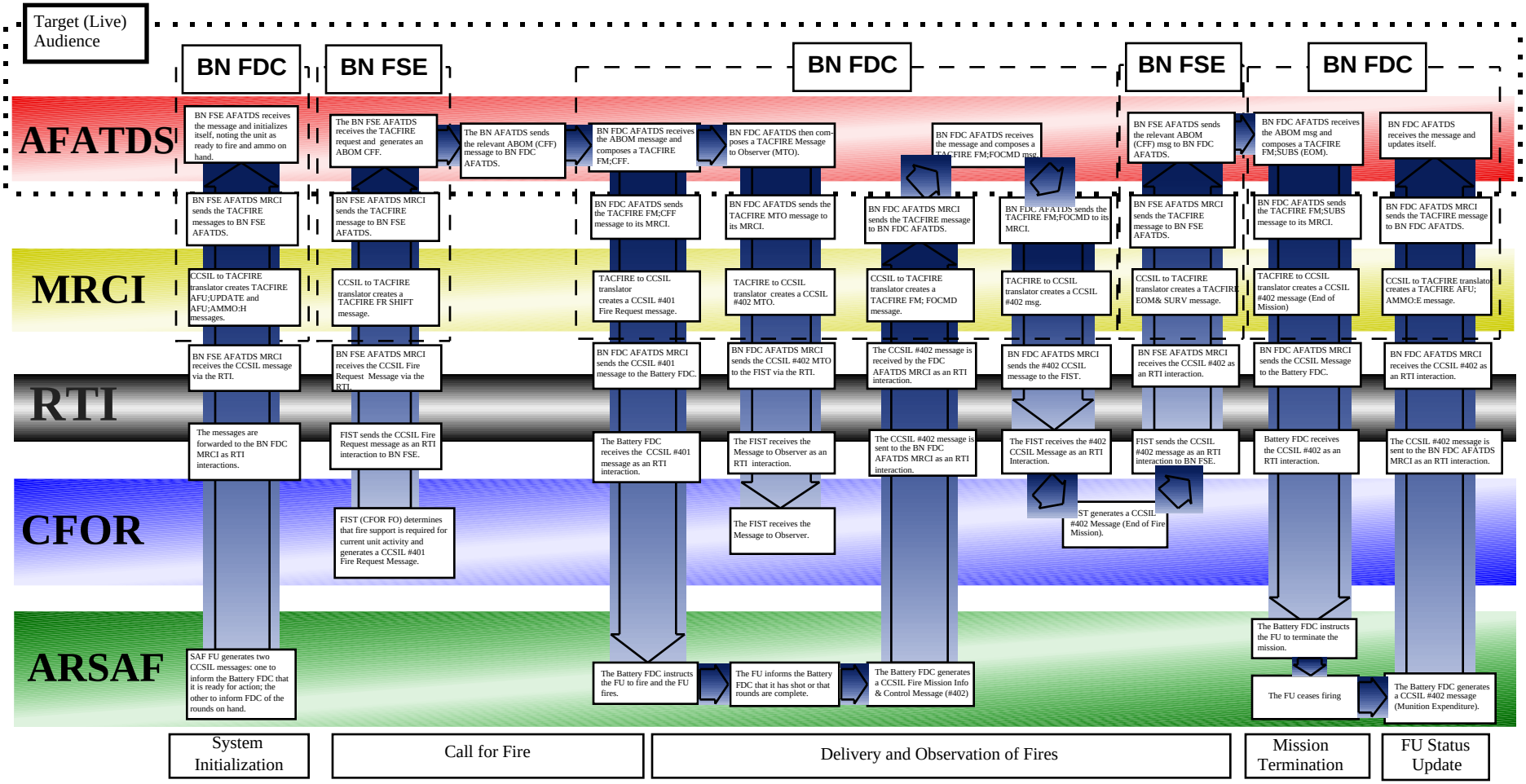
AFATDS Linkage
Scenario

- SAF firing unit sends messages informing FSE of its location and readiness status.
- CFOR FO calls for fire
- FSE receives the fire request and forwards it to FDC
- FDC passes the call for fire (CFF) to the SAF firing unit.
- Concurrently, FDC sends a Message to Observer that the mission is underway.
- SAF firing unit receives the CFF and fires the mission
- SAF firing unit informs FDC that rounds are fired.
- FDC sends a message to the FO that rounds are fired.
- FO reports effect on target and ends mission to the FSE
- FSE sends a message to the SAF firing unit that the mission is ended.
- The unit stands down.
- SAF firing unit generates a message to FDC informing them of their ammo usage.

AFATDS Linkage
Message Set Used

Required Messages	V1.3 Messages	Remarks
• TACFIRE AFU;UPDATE (Readiness Update) • TACFIRE AFU;AMMO:H (Ammo On Hand) • TACFIRE FR SHIFT (Fire Request Shift) • TACFIRE FM;FOCMD (Fwd Obsr Commands) • TACFIRE EOM&SURV (End of Mission & Surv) • TACFIRE AFU;AMMO:E (Ammo Expended) • TACFIRE FM;CFF (Call for Fire) • TACFIRE MTO (Message to Observer) • TACFIRE FOCMD (Fwd Obsr Commands) • TACFIRE FM;SUBS (Subsequent Commands) • TACFIRE FR GRID (Fire Request Grid)	· TACFIRE FOCMD (Fwd Obsr Commands) to CCSIL 402 · CCSIL 401 to TACFIRE FR GRID (Fire Request Grid)	

AFATDS - ARSAF Message Interaction



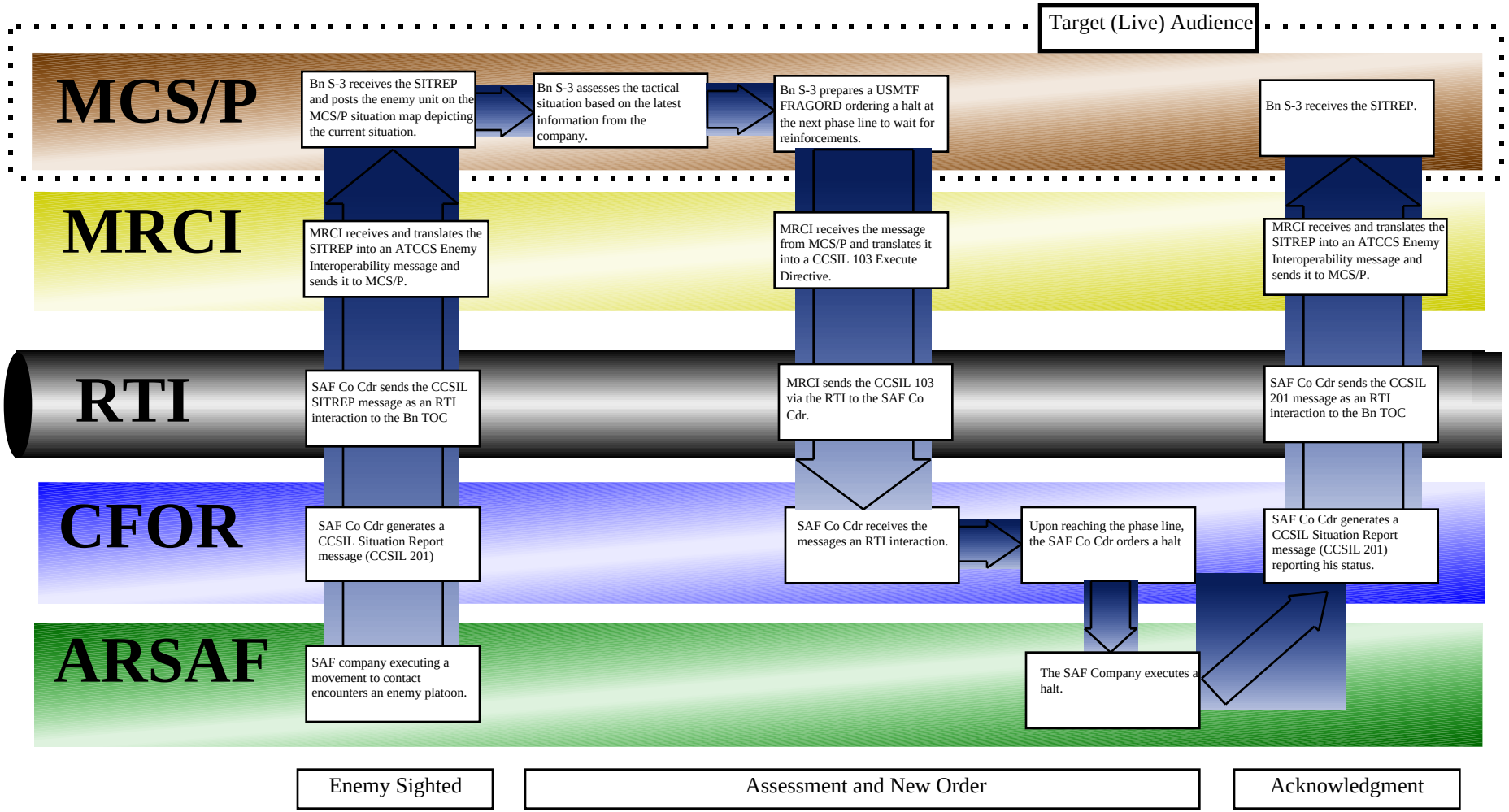
MCS/P Linkage
Scenario

- SAF company executing a movement to contact encounters an enemy platoon and generates a SITREP to BN
- The BN S-3 receives the message and posts the information to MCS/P
- BN S-3 prepares a message to the unit ordering a halt at the next phase line.
- The message is transmitted to the CFOR Co Cdr
- The company halts at the phase line.
- CFOR Co Cdr sends a SITREP reporting status
- BN S-3 receives the SITREP and posts the data to MCS/P

MCS/P Linkage
Message Set Used

Required Messages	V1.3 Messages	Remarks
· USMTF C400 Situation Report · USMTF A423 Operations Order · ATCCS S201 Geometry Message · ATCCS S302 Free Text Message · ATCCS S309 Enemy InteroperabilityMessage · ATCCS E500 Air Strike Warning · ATCCS S507L Resources Location (Unit Loc Data) · ATCCS S507R ResourcesResources (Unit Resources Data) · ATCCS S507S Resources Supply (Supply Point Data) · ATCCS S509 Commander's Tracked Item List	· USMTF C400 SITREP to CCSIL SITREP (#201) · ATCCS S302 Free Text Message to CCSIL Execute Directive (#103) · ATCCS S507 Resource Message to CCSIL SITREP (#201) · CCSIL 201 SITREP to ATCCS S507L Resource Message-Location · CCSIL 201 SITREP to ATCCS S309 Enemy Interoperability	

MCS/P - ARSAF Message Interaction



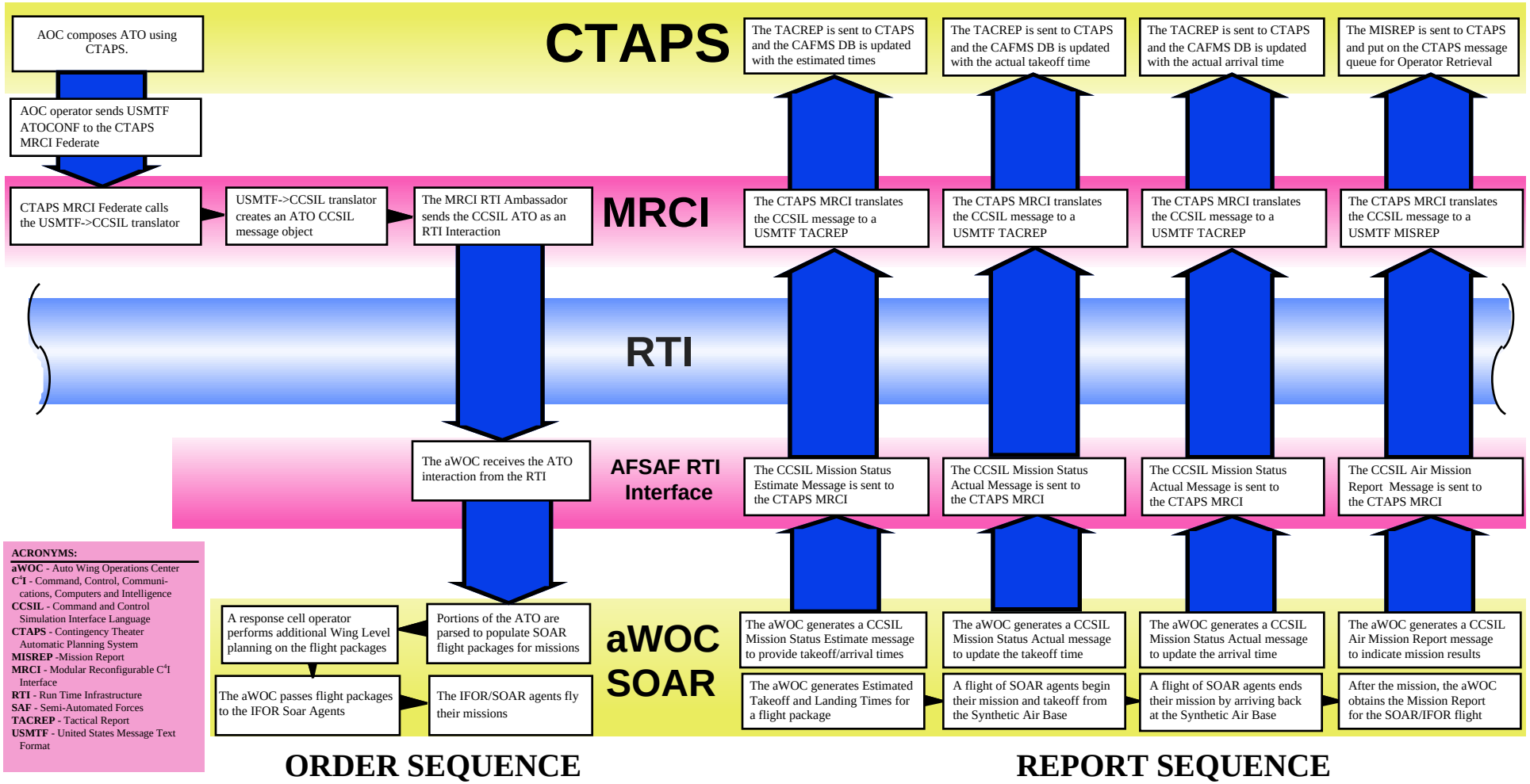
CTAPS Linkage Scenario

- AOC composes ATO Using CTAPS.
- The is sent from CTAPS to the aWOC (Simulated Wing Operations Center).
- The aWOC generates flight packages and gives them to AFSAF SOAR pilots.
- The aWOC generates estimated takeoff and landing times for the flight packages and sends these TACREPS to CTAPS, where they are inserted into the CAFMS DB.
- The AFSAF Soar pilots begin their missions and takeoff from the Synthetic Air Base. The aWOC sends the takeoff times as TACREPS to CTAPS, where they are inserted into the CAFMS DB.
- The AFSAF Soar pilots fly their missions.
- The AFSAF Soar pilots end their missions and arrive at the Synthetic Air Base. The aWOC sends the arrival times as TACREPS to CTAPS, where they are inserted into the CAFMS DB.
- The aWOC obtains the mission reports from the AFSAF SOAR pilots and generates mission results and sends these as MISREP to CTAPS, where they are inserted into the CTAPS message queue.

CTAPS Linkage
Message Set Used

Required Messages	V1.3 Messages	Remarks
• USMTF ATO • USMTF TACREP • USMTF MISREP	· CCSIL 201 SITREP to USMTF SITREP · CCSIL 1700 Mission Status Report (ETD, ETA) to USMTF TACREP · CCSIL 1701 Mission Status Report (ATD, ATA) to USMTF TACREP · CCSIL 1702 Mission Deviation Report to USMTF TACREP · CCSIL 1707 Air Mission Report to USMTF MISREP · USMTF ATO to CCSIL 1600 (Air Tasking Order)	

CTAPS - AFSAF Message Interaction



ACRONYMS:

aWOC - Auto Wing Operations Center
C^{4}I - Command, Control, Communications, Computers and Intelligence
CCSIL - Command and Control Simulation Interface Language
CTAPS - Contingency Theater Automatic Planning System
MISREP -Mission Report
MRCI - Modular Reconfigurable C^{4}I Interface
RTI - Run Time Infrastructure
SAF - Semi-Automated Forces
TACREP - Tactical Report
USMTF - United States Message Text Format

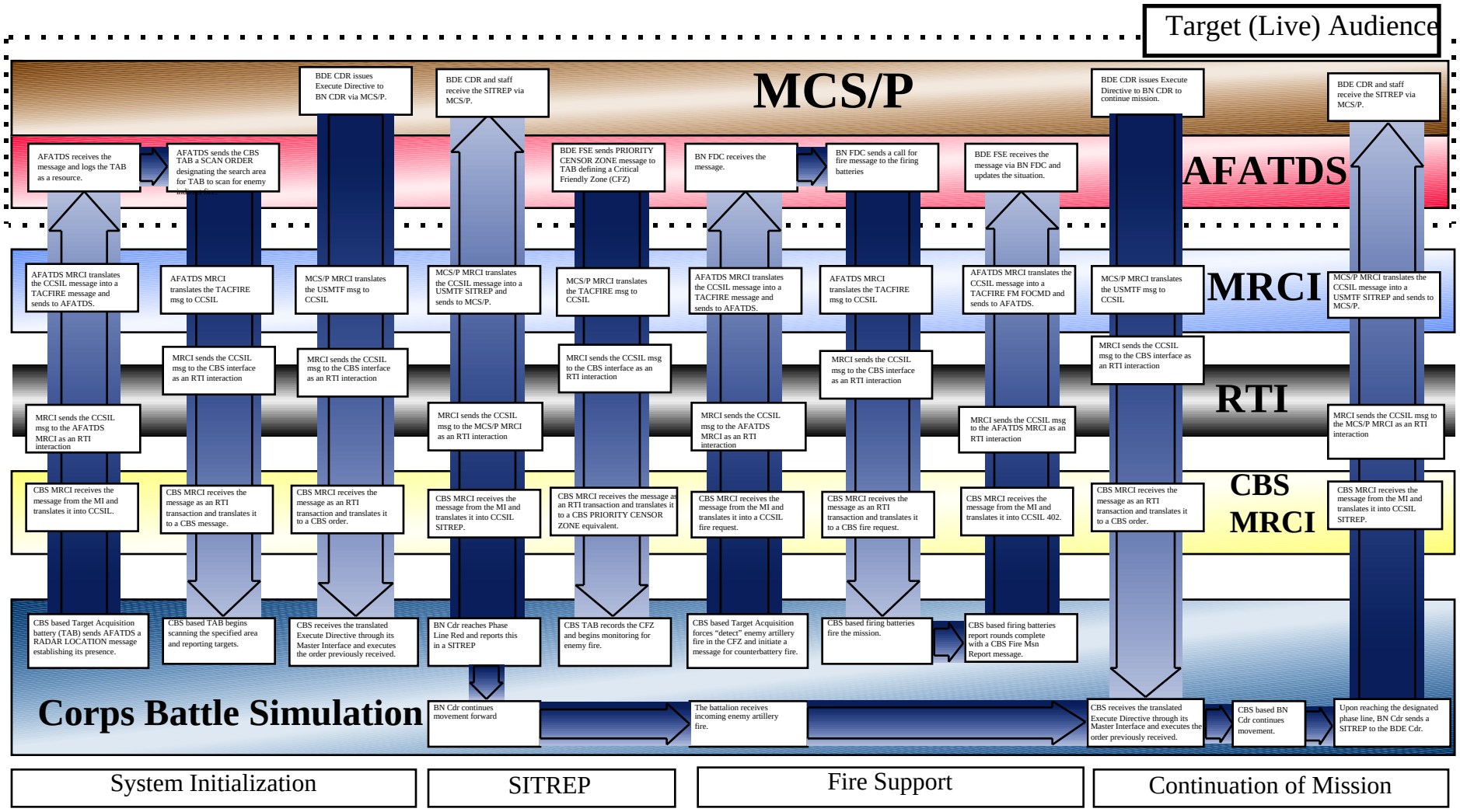
CBS Linkage
Scenario

- CBS Target Acquisition Battery (TAB) sends AFATDS a RADAR LOCATION message.
- AFATDS sends CBS TAB a SCAN ORDER designating the area to scan.
- CBS TAB begins sending TARGET messages to the BDE FSE (Omitted).
- BDE Cdr issues an execute directive to BN Cdr (CBS) to move out.
- BN Cdr sends SITREP to BDE Cdr that he is passing Phase Line Red.
- BDE FSE sends a PRIORITY CENSOR ZONE message to the CBS TAB establishing a Critical Friendly Zone (CFZ) along the Battalion's route of movement past Phase Line Red.
- CBS TAB detects hostile artillery fire impacting in the CFZ and sends a PRIORITY TARGET message directly to the BN FDC.
- BN FDC sends the fire mission to the firing battery (CBS).
- CBS firing battery fires the mission and reports back thru BN FDC to BDE FSE.
- BDE Cdr issues execute directive to BN Cdr to continue mission and report reaching objective.
- BN Cdr sends SITREP reporting reaching objective.

CBS Linkage
Message Set Used

Required Messages	V1.3 Messages	Remarks
• CBS C103 Execute Directive • CBS C201 SITREP • CBS C401 Fire Request • CBS C402 Fire Mission Info • FIREFINDER PRIORITY/CENSOR ZONE (CBS Equivalent) • PRIORITY TARGET REPORT (CBS Equivalent) • TACFIRE FM;FOCMD (CBS Equivalent) • FIREFINDER RADAR LOCATION (CBS Equivalent) • FIREFINDER RADAR SEARCH AREA (CBS Equivalent)	· CBS C201 SITREP to CCSIL 201 SITREP · CBS C402 Fire Mission Report to CCSIL 402 Fire Mission Info and Control · CCSIL 103 Execute Directive to CBS C103 Move Order · CCSIL 401 Fire Request to CBS C401 Fire Request	

CBS -MCS/P & AFATDS Message Interaction



AFSAF Linkage Scenario

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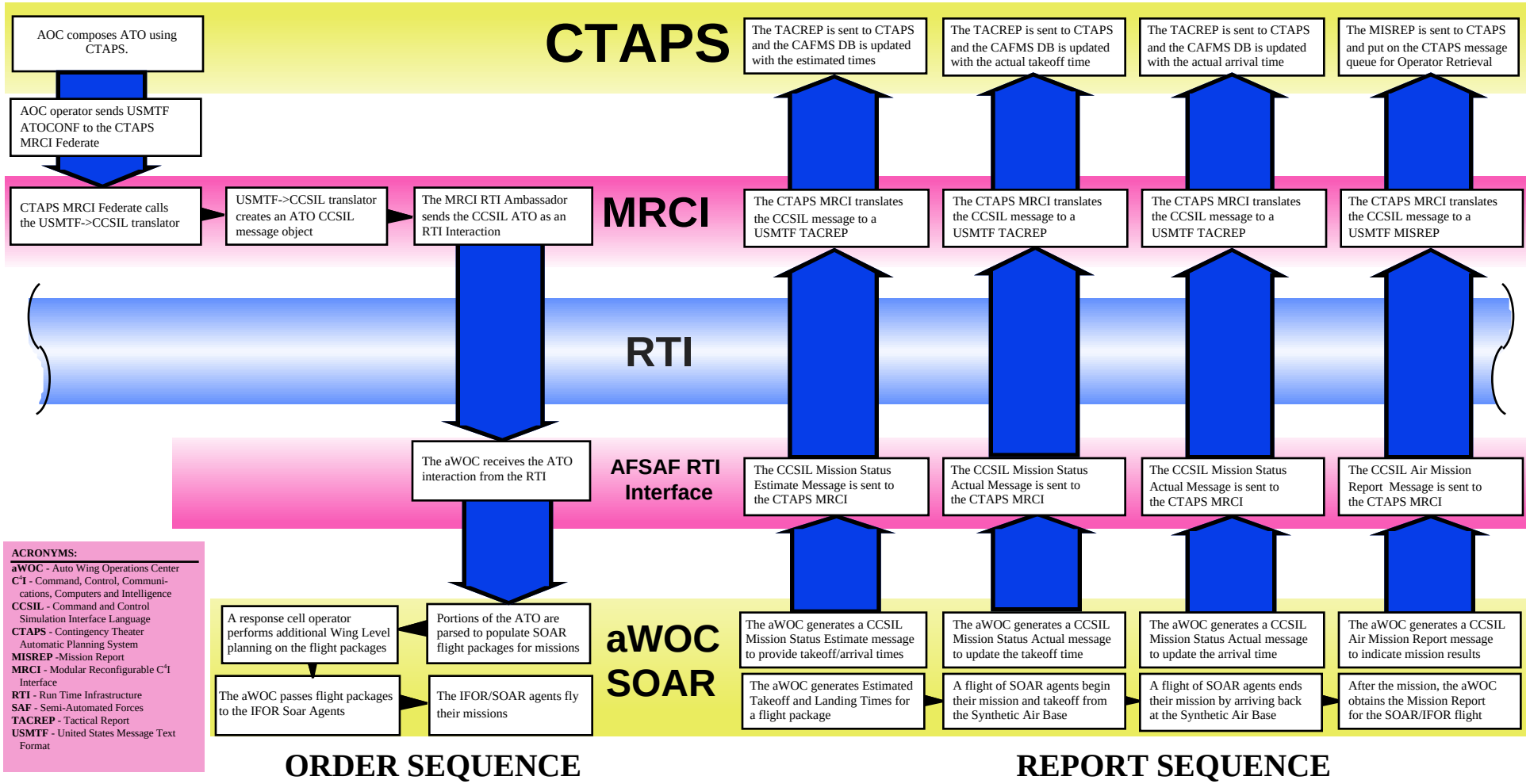
- The is sent from CTAPS to the aWOC (Simulated Wing Operations Center).
- The aWOC generates flight packages and gives them to AFSAF SOAR pilots.
- The aWOC generates estimated takeoff and landing times for the flight packages and sends these TACREPS to CTAPS, where they are inserted into the CAFMS DB.
- The AFSAF Soar pilots begin their missions and takeoff from the Synthetic Air Base. The aWOC sends the takeoff times as TACREPS to CTAPS, where they are inserted into the CAFMS DB.
- The AFSAF Soar pilots fly their missions.
- The AFSAF Soar pilots end their missions and arrive at the Synthetic Air Base. The aWOC sends the arrival times as TACREPS to CTAPS, where they are inserted into the CAFMS DB.
- The aWOC obtains the mission reports from the AFSAF SOAR pilots and generates mission results and sends these as MISREP to CTAPS, where they are inserted into the CTAPS message queue.

AFSAF Linkage
Message Set Used

Required Messages	V1.3 Messages	Remarks
• CCSIL 1600 Air Tasking Order • CCSIL 1700 Mission Status Report (ETD, ETA) • CCSIL 1701 Mission Status Report (ATD, ATA) • CCSIL 1707 Air Mission Report	· CCSIL 201 SITREP to USMTF SITREP · CCSIL 1700 Mission Status Report (ETD, ETA) to USMTF TACREP · CCSIL 1701 Mission Status Report (ATD, ATA) to USMTF TACREP · CCSIL 1702 Mission Deviation Report to USMTF TACREP · CCSIL 1707 Air Mission Report to USMTF MISREP • USMTF ATO to CCSIL 1600 (Air Tasking Order)	

CTAPS - AFSAF Message Interaction



ACRONYMS:

aWOC - Auto Wing Operations Center
C^{4}I - Command, Control, Communications, Computers and Intelligence
CCSIL - Command and Control Simulation Interface Language
CTAPS - Contingency Theater Automatic Planning System
MISREP -Mission Report
MRCI - Modular Reconfigurable C^{4}I Interface
RTI - Run Time Infrastructure
SAF - Semi-Automated Forces
TACREP - Tactical Report
USMTF - United States Message Text Format

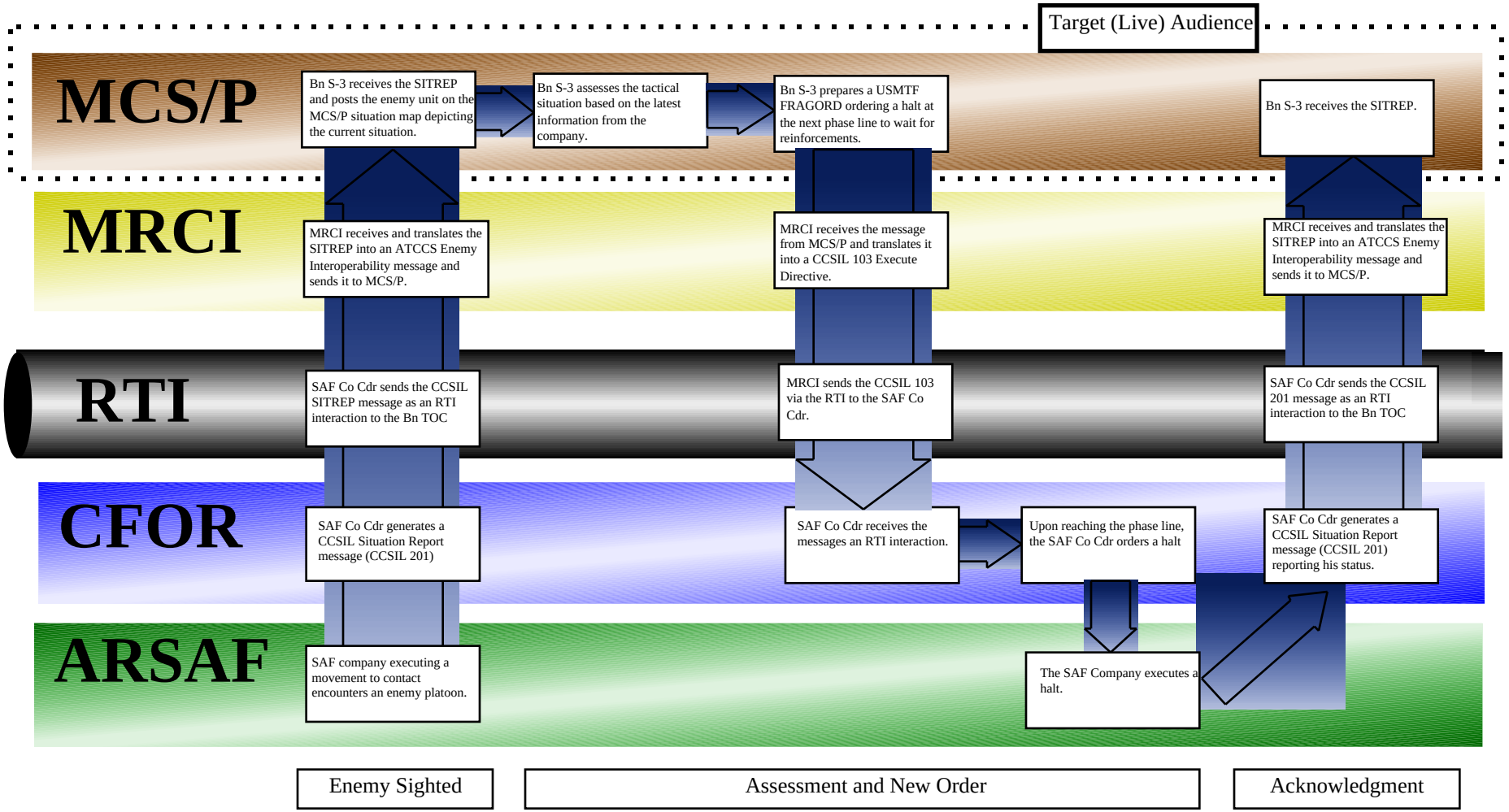
ARSAF Linkage
Scenario

- SAF company executing a movement to contact encounters an enemy platoon and generates a SITREP to BN
- The BN S-3 receives the message and posts the information to MCS/P
- BN S-3 prepares a message to the unit ordering a halt at the next phase line.
- The message is transmitted to the CFOR Co Cdr
- The company halts at the phase line.
- CFOR Co Cdr sends a SITREP reporting status
- BN S-3 receives the SITREP and posts the data to MCS/P

ARSAF Linkage
Message Set Used

Required Messages	V1.3 Messages	Remarks
· CCSIL 201 Situation Report · CCSIL 103 Execute Directive	· USMTF C400 SITREP to CCSIL SITREP (#201) · ATCCS S302 Free Text Message to CCSIL Execute Directive (#103) · ATCCS S507 Resource Message to CCSIL SITREP (#201) · CCSIL 201 SITREP to ATCCS S507L Resource Message-Location · CCSIL 201 SITREP to ATCCS S309 Enemy Interoperability	

MCS/P - ARSAF Message Interaction



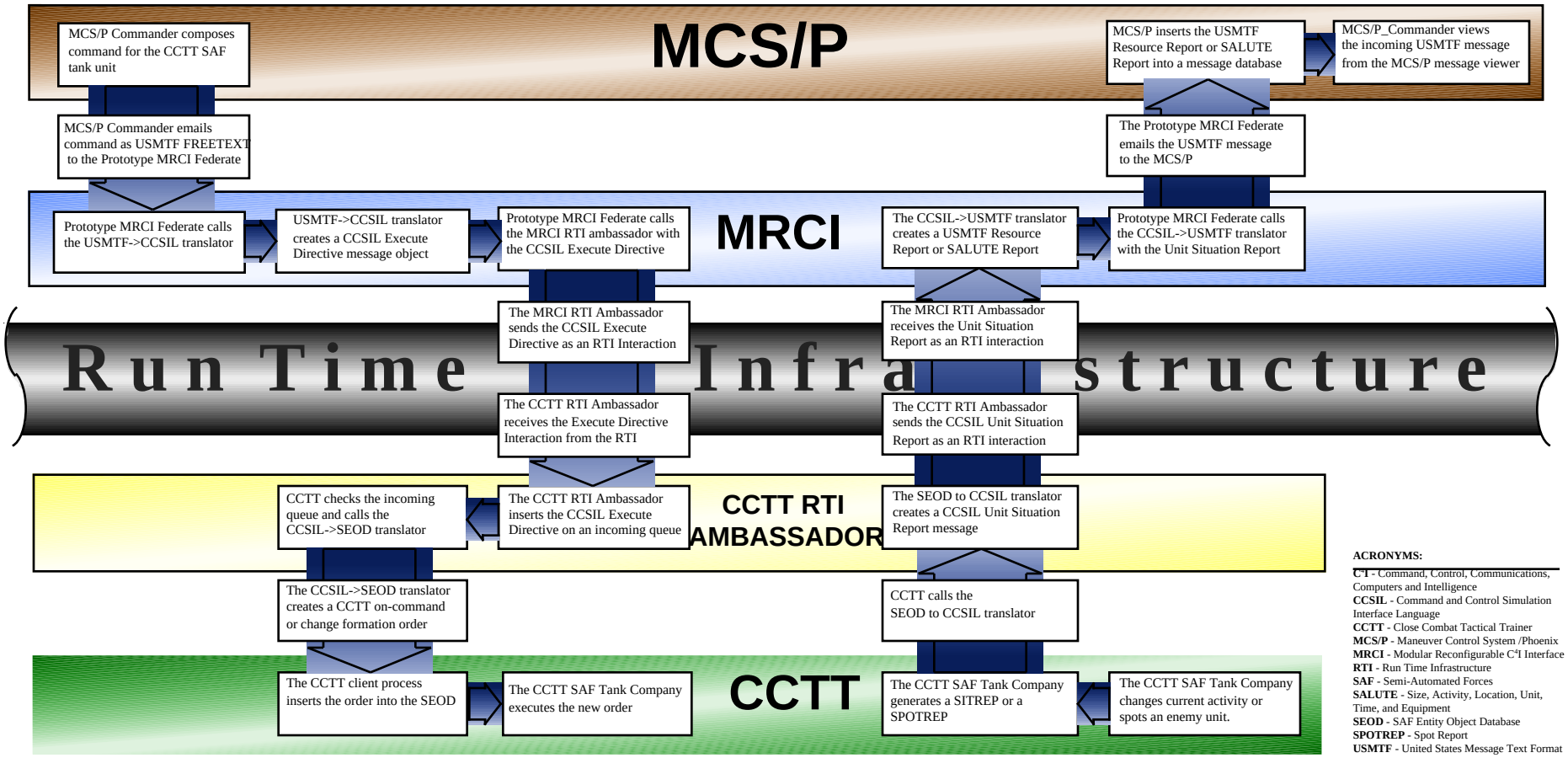
CCTT SAF Linkage
Scenario

- Bn Cdr issues an Execute Directive to CCTT SAF company to execute movement.
- SAF company begins movement on a designated route.
- En route, SAF company encounters and engages an enemy platoon.
- SAF company reports contacts and status in SITREP
- Upon reaching designated halt point, SAF company halts, assumes defensive posture, and sends SITREP.
- Bn Cdr issues Execute Directive to continue movement.
- SAF company executes movement.
- En route, SAF company again encounters and engages and enemy platoon.
- SAF company reports contacts and status in SITREP
- Upon reaching designated halt point, SAF company halts, assumes defensive posture, and sends SITREP.

CCTT SAF Linkage
Message Set Used

Required Messages	V1.3 Messages	Remarks
· CCSIL 201 Situation Report · CCSIL 103 Execute Directive	· USMTF C400 SITREP to CCSIL SITREP (#201) · ATCCS S302 Free Text Message to CCSIL Execute Directive (#103) · ATCCS S507 Resource Message to CCSIL SITREP (#201) · CCSIL 201 SITREP to ATCCS S507L Resource Message-Location · CCSIL 201 SITREP to ATCCS S309 Enemy Interoperability	

MCS/P - CCTT SAF Message Interaction



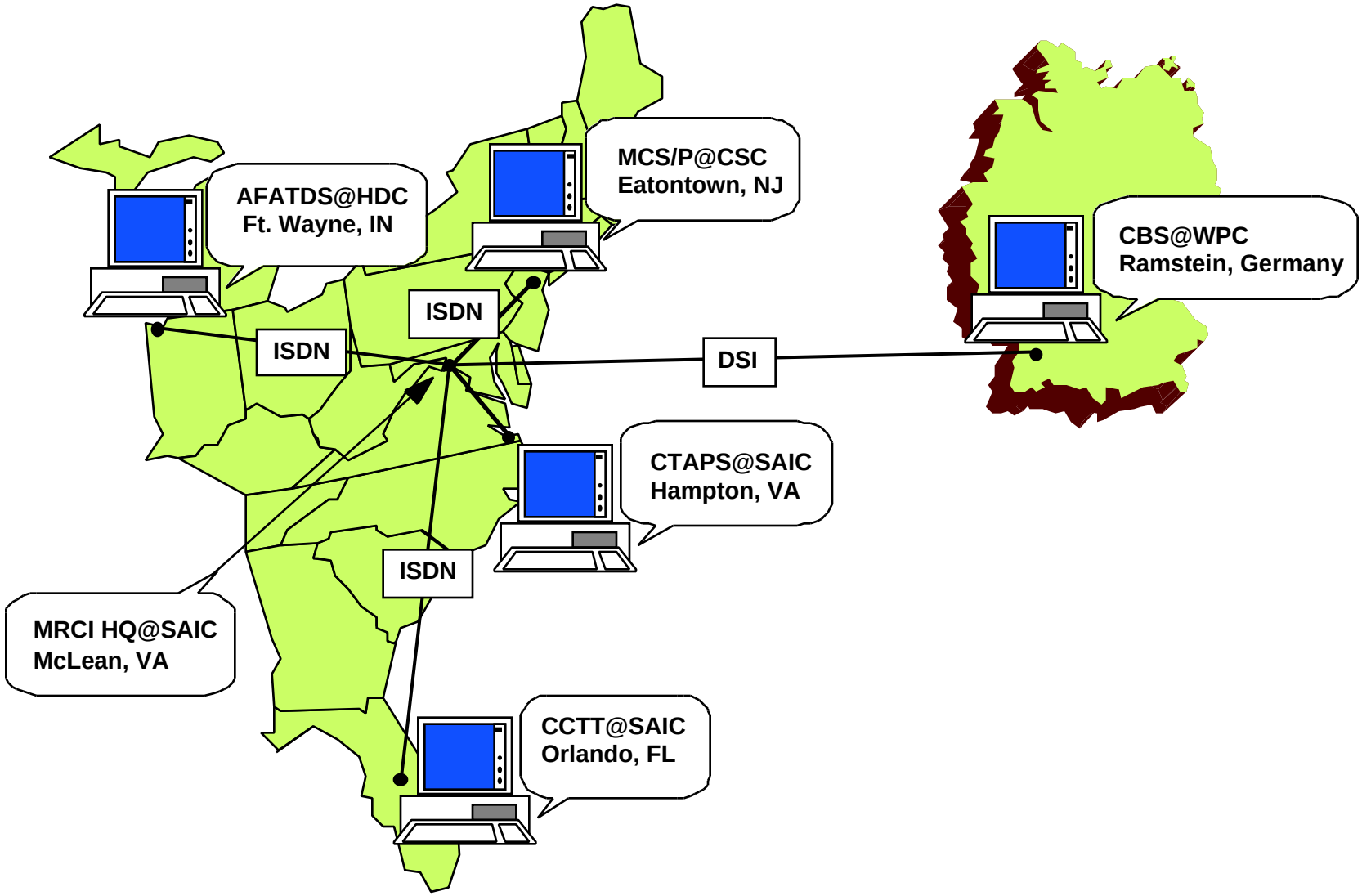
ACRONYMS:

C4I - Command, Control, Communications, Computers and Intelligence
CCSIL - Command and Control Simulation Interface Language
CCTT - Close Combat Tactical Trainer
MCS/P - Maneuver Control System /Phoenix
MRCI - Modular Reconfigurable C4I Interface
RTI - Run Time Infrastructure
SAF - Semi-Automated Forces
SALUTE - Size, Activity, Location, Unit, Time, and Equipment
SEOD - SAF Entity Object Database
SPOTREP - Spot Report
USMTF - United States Message Text Format

ORDER SEQUENCE OF ACTIVITY

REPORT SEQUENCE OF ACTIVITY

MRCI Distributed Development and Test Environment



MRCI Testing Program (1 of 4)

Test Site Name & Location	Participating Organizations	Software to be Tested	Tests to be Performed
MRCI CSCI Testing			
MCS/P SSI Development Facility, Eatontown, NJ	CSC	MCS/P MCS/P SSI MSST Server	· Client/Server Test
AFATDS SSI Development Facility, Ft. Wayne, IN	HDC	AFATDS AFATDS SSI MSST Server	· Client/Server Test
CTAPS SSI Development Facility, Hampton, VA	SAIC-H	CTAPS CTAPS SSI MSST Server	· Client/Server Test
CBS SSI Development Facility, Warrior Preparation Center (WPC), Germany	SAIC-G	CBS CBS SSI MSST Server	· Client/Server Test

Legend

SAIC-H	SAIC Hampton
SAIC-G	SAIC Germany
SAIC-M	SAIC McLean
SAIC-O	SAIC Orlando

MRCI Testing Program (2 of 4)

Test Site Name & Location	Participating Organizations	Software to be Tested	Tests to be Performed
MRCI System Testing			
MRCI System Testbed, McLean, VA	SAIC-M	MSST CLIENT MRCI S/T ARSAF MRIMAIN	· Client/Server Test · Message Parse/ Translate/Format Test · RTI Interoperability Test · MRCI Reconfigurability Test · RAM Test
MCS/P-CBS Testbed AFATDS-CBS Testbed Warrior Preparation Center (WPC), Germany	SAIC-G	CBS CBS SSI MRCI S/T MSST CLIENT	· MCS/P-CBS Interoperability Test · AFATDS-CBS Interoperability Test
MCS/P-ARSAF Testbed, McLean, VA	SAIC-M	MCS/P SSI MRCI S/T ARSAF	· MCS/P-ARSAF Interoperability Test
AFATDS-ARSAF Testbed, McLean, VA	SAIC-M	AFATDS SSI MRCI S/T ARSAF	· AFATDS-CFOR Command Entity Interoperability Test · AFATDS-ARSAF Interoperability Test
MCS/P-CCTT Testbed, Orlando, FL	SAIC-O	MSST CLIENT MCS/P SSI MRCI S/T CCTT	· MCS/P-CCTT Interoperability Test
CTAPS-AFSAF Testbed, Orlando, FL	SAIC-O SAIC-H	CTAPS SSI MRCI S/T AFSAF	· CTAPS-AFSAF Interoperability Test

MRCI Testing Program (3 of 4)

Test Site Name & Location	Participating Organizations	Software to be Tested	Tests to be Performed
MRCI Federate Testing			
HLA C2 Testbed, Orlando, FL	AEgis (Test Director) SAIC-O SAIC-M	AFATDS AFATDS SSI CTAPS CTAPS SSI MCS/P MCS/P SSI MRCI S/T Eagle	· HLA C2 Federation Testing
STOW SEID Testbed, Arlington, VA	STOW SEID (Test Director) SAIC-M SAIC-O SAIC-H HDC CSC	AFATDS AFATDS SSI CTAPS CTAPS SSI MCS/P MCS/P SSI MRCI S/T AFSAF ARSAF	· STOW Federation Integration Testing

MRCI Testing Program (4 of 4)

Test Site Name & Location	Participating Organizations	Software to be Tested	Tests to be Performed
MRCI Federate Testing			
National Simulation Center (NSC), Fort Leavenworth, KS	STOW SEID (Test Director) SAIC-M CSC HDC	AFATDS AFATDS SSI MCS/P MCS/P SSI MRCI S/T ARSAF	· STOW Federation Operational Test (OT) · STOW Federation Full Scale Test (FST)
What If Simulation System for Advanced Research and Development (WISSARD), NAS Oceana, VA	STOW SEID (Test Director) SAIC-H	CTAPS CTAPS SSI MRCI S/T AFSAF	· STOW Federation Operational Test (OT) · STOW Federation Full Scale Test (FST)
National Simulation Center (NSC), Fort Leavenworth, KS	NSC (Test Director) SAIC-M CSC HDC	AFATDS AFATDS SSI MCS/P MCS/P SSI MRCI S/T CBS	· Joint Training Confederation (JTC) ALSP Special Model Validation Testing

AGENDA (2 of 4)

1050-1200	**Prototype MRCI (V1.3) Development Status** **C4I System Capabilities (including SOMs)** **-AFATDS** **-MCS/P Baseline** **-CTAPS** **Simulation Capabilities** **-CBS** **-AFSAF** **-ARSAF** **-CCTT** **ACESS Development** **Testing Program**	**L. Griggs/M. Hieb**
1200-1300	**Lunch**	

AGENDA (3 of 4)

1300-1400	**Application of Quality Factors to the Evaluation of the MRCI Prototype** **Functionality** **Usability** **Reliability** **Maintainability** **Availability** **Flexibility** **Portability** **Testability** **Reusability [Special Emphasis Area]** **Context** **Modules**	**L. Griggs/M. Hieb**
1400-1430	**The Way Ahead**	**M. Cosby**

Original MRCI General and Technical Requirements (as of Feb. 96) (1 of 13)

1. MRCI execution should be transparent to the user and non-intrusive to the C4I system during setup and use.
2. MRCI shall be able to operate in real time and/or at a speed which results in the perception of real time (perceptible real-time) to the C4I system using the MRCI. MRCI must not preclude or inhibit the use of time management schemes supported by the RTI.
3. MRCI shall operate with dynamic changes in C4I systems task organization and in all mission threads (e.g. planning through BDA and replanning to retasking).
4. MRCI shall operate during, and recover from, system failures on either its RTI or live C4I side.
5. MRCI shall support C4I systems representing echelons above Corps to platform level, e.g. infantryman operating autonomously.

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (2 of 13)

6. MRCI shall not restrict the HLA Federation operations with respect to security level.
7. MRCI shall support the interface to C4I systems by data, information or C2 formats and shall not introduce additional layers of complexity to the simulation interfaces to the RTI.
8. MRCI shall be able to go to war and operate across operational warfighting networks.
9. MRCI shall support bi-directional interactions between C4I systems and the HLA-based Federation.
10. MRCI shall comply with the five Federation and five Federate rules of the HLA.

10.1 Federations must have an HLA Federation Object Model (FOM), documented using the HLA OMT.

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (3 of 13)

10.2 In a federation, all object representation (ownership or reflection) occurs in the federates, not in the runtime infrastructure (RTI).

10.3 During a federation execution, data exchange (attribute values and interactions) among instances of objects defined in the FOM represented (owned or reflected) in different federates occurs via the RTI).

10.4 During a federation execution, federates interface with the runtime infrastructure (RTI) in accordance with the HLA interface specification.

10.5 During a federation execution, an attribute of an instance of an object can be owned by only one federate at any given time.

10.6 Federates must have an HLA Simulation Object Model (SOM) documented using the HLA OMT.

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (4 of 13)

10.7 Federates must be able to publish/reflect any attributes of objects in their SOM and exercise SOM object interactions externally.

10.8 Federates must be able to own or reflect attributes and to transfer/accept ownership of attributes dynamically during a federation execution, as specified in their SOM.

10.9 Federates must be able to vary the conditions (e.g. thresholds) under which they provide updates of published attributes of objects according to their SOM.

10.10 Federates must be able to manage local time in a way which will allow them to coordinate data exchange with other members of a federation in accordance with at least one HLA time management service.

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (5 of 13)

11. MRCI must facilitate interoperation with an HLA federation using all six RTI service categories, i.e., Federation Management, Time Management, Object Management, Ownership Management, Declaration Management and Data Distribution Management.
12. MRCI shall provide the throughput and transport capabilities to facilitate the rapid exchange and synchronization of C4I and Simulation databases (database reconciliation) as executed by the future HLA exercise generation components.
13. MRCI shall facilitate the collection of both FOM and non-FOM data as defined within the C4I system SOM.
14. MRCI shall facilitate the establishment of an application-to-application session between the RTI and the C4I system.

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 97) (6 of 13)

15. MRCI shall provide a mechanism for resynchronization with C4I systems following degraded operations (e.g. tactical picture re-establishment).
16. MRCI shall be GCCS DII COE compliant.
17. MRCI applications shall be fully interoperable with Ada 95.
18. MRCI shall support next generation releases of C4I system software (e.g. MCS Consolidated Platform ATDS V1.0.06).
19. The MRCI/C4I SOM shall support FEDEPs produced for STOW demonstrations and exercises which include CBS, OpenSAF, EADSIM participation and entity-level interactions.

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (7 of 13)

20. To the extent practical, MRCI reconfigurable modules shall be reusable among instances of C4I MRCI combinations.
21. MRCI shall support flow of both perceived and ground-truth data, information and C2 transactions consistent with applicable FOM and SOM definitions for Federations in which it participates.
22. MRCI design shall not be restricted by the use of legacy simulation-to-real world interface solutions.
23. MRCI design shall not be restricted by the use of alternate redundant mechanisms to the RTI.
24. MRCI shall be developed using a language for specification of formats, timing and conversion requirements of data, information and C2 interchange in clear, consistent and concise interface specifications of internal and external interfaces.

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (8 of 13)

25. MRCI shall use well-defined application program interface between layers and the support services.
26. MRCI shall optimize the interdependencies between software components so that the impact of change is localized.
27. MRCI shall reduce the number of, and special training required for, system administrators, network administrators, and other exercise operator personnel.
28. MRCI shall minimize life-cycle costs and be logistically supportable.
29. MRCI shall be flexible, extensible, and modifiable to capitalize on current and emerging industry accepted standards and commercially available products to the maximum extent possible to support the system requirements and to streamline upgrades.

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (9 of 13)

30. MRCI shall provide sufficient flexibility, modifiability and performance to support changes and extensions to the interfaces on both the C4I and RTI sides.

[Background Information Only - Not Briefed]

31. MRCI shall execute in a distributed manner across heterogeneous platforms including current fielding systems.

32. MRCI software shall be portable to different vendor host platforms with minimal or no modification.

Covered in Consolidated Form in Issues Section

33. MRCI shall provide an experimental capability to interface AWSIM/R to TBMCS IAW the TBMCS SOM.

33.1 MRCI shall provide the capability of the current PRW and CWIC interfaces.

33.2 MRCI shall provide the capability to interface existing simulations with current and rapidly-prototyped C4I systems.

Original MRCI General and Technical Requirements (as of Feb. 96) (10 of 13)

34. MRCI shall provide an experimental capability to interface NASM/AP to TBMCS.

34. [Background Information Only – Not Briefed] MRCI shall provide the capability to be used with next-generation simulations and the Prototype Federation products.

35. MRCI shall provide an experimental capability to interface AFSAF to TBMCS.

35. [Background Information Only – Not Briefed] MRCI shall support the transmission of TBMCS data for virtual mission planning and execution within AFSAF.

35.2 MRCI shall support operations in Federations where STOW SEID SI and OpenSAF are used IAW the appropriate FOM.

36. The design of the MRCI shall not preclude the addition of a module to support direct C4I system database access (vice message interchange) when specified in future C4I SOMs.

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (11 of 13)

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

37. MRCI must support segregation, labeling and simultaneous [illegible] in all of its outputs on both C4I and RTI sides.
38. MRCI must support the populating of messages with relatively unstructured text content to the C4I system and within the CCSIL-like message converter, while correctly maintaining the intent of such messages.
39. MRCI must support interpreting messages with relatively unstructured text content from the C4I system and within the CCSIL-like message converter, while correctly maintaining the intent of such messages.

Original MRCI General and Technical Requirements (as of Feb. 96) (12 of 13)

40. The Federation Design in which the MRCI participates must accommodate scaling, normalizing or otherwise harmonizing data and information transactions where "data mismatches" would result in unrealistic representations of the battlespace to the C4I system.
41. MRCI must provide functionality compatible with the STOW SSF and interoperation facilities in support of STOW EOMs.
42. MRCI must maintain content integrity and conformity in all internal data-to-data/ information-to-information/ C2-to-C2 transformations.
43. MRCI must not introduce spatial or temporal inconsistencies into the C4I system's "world view".

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Original MRCI General and Technical Requirements (as of Feb. 96) (13 of 13)

- **43.1 Via the MRCI, simulated entities must be able to affect the live C4I systems and vice versa. Simulated entities must also be able to control communications between live C4I systems; data, information, and C2 flow between live and simulated world shall be influenced in quantity and quality based on environment, geometric, system and interoperability parameters and issues elsewhere in the Federation.**

[Background Information Only - Not Briefed]

Covered in Consolidated Form in Issues Section

Software Quality Factors

- Software Quality Definition
  - "The ability of software to meet its specified requirements." (MIL-STD-498 - Software Development and Documentation)
- Software Quality Factors
  - commonly referred to as "…ilities" to distinguish them from performance requirements
- Key Software Quality Factors *(as enumerated and defined in MIL-STD-498 Software Requirements Specification (SRS) data item description (DID))*
  - Functionality: ability to perform all required functions
  - Usability: ability to be easily learned and used
  - Reliability: ability to perform with correct, consistent results
  - Maintainability: ability to be easily corrected ***and enhanced***
  - Availability: ability to be accessed and operated when needed
  - Flexibility: ability to be easily adapted to changing requirements
  - Portability: ability to be easily modified for a new environment
  - Testability: ability to be easily and thoroughly tested
  - Reusability: ability to be used in multiple applications

Functionality

- Definition
  - Functionality: ability to perform all required functions
- Applicable MRCI System Requirements
  - #2, 3, 6-15, 19, 21-23, 25, 31, 33-34, 35-35.2, 37-40, 42-43.1: I.e., all MRCI performance requirements (See Backup slides for complete text of all MRCI system requirements.)
- Verification Methods and Criteria
  - To be provided via MRCI DO #20 CDRL Software Test Descriptions (STD)
    - A001BA (MRCI - HLA C2 STD)
      - To be published NLT 45 days prior to first HLA-C2 test event
    - A001BB (MRCI - STOW 97 STD)
      - SEID C4I-SAF Interoperability Testing (4/28-5/2/97)
      - OT3 (5/26-5/30/97)
    - A001BC (MRCI - JTC STD)
      - Prairie Warrior 97 (5/12-516/97
- MRCI V1.3 Snapshot
  - Provided ICW DMSO IPR Demonstration

Usability (1 of 2)

- Definition
  - Usability: ability to be easily learned and used
- Applicable MRCI System Requirements
  - #1: MRCI execution should be transparent to the user and non-intrusive to the C4I system during setup and use.
  - #27: MRCI shall reduce the number of, and special training required for, system administrators, network administrators, and other exercise support personnel
- Verification Methods and Criteria
  - Methods
    - STOW Federation:
      - Existing Subject Matter Expert (SME) **EVALUATION** forms
      - JWID 97 DISA Assessment Process
    - HLA-C2 Federation: TBD
    - JTC Federation: Existing Special Model Validation process (similar to STOW SME **EVALUATION**)

Usability (2 of 2)

- **MRCI V1.3 Snapshot**
  - **MRCI V1.3 is first version of MRCI server/translator with GUI. No actual user evaluations available at this writing**
  - **C4I SSIs each have a GUI that is similar in look and feel to the basic C4I system. No actual user evaluations available at this writing**

Reliability

- Definition
  - Reliability: ability to perform with correct, consistent results
- Applicable MRCI System Requirements
  - #42: MRCI must maintain content integrity and conformity in all internal data-to-data / information-to-information / C2-to-C2 transformations..
- Verification Methods and Criteria
  - Methods
    - Post-federation execution **ANALYSIS** of recorded C4I-In, C4I-Out, Sim-In, Sim-Out message traffic against translator incoming / outgoing message log files
  - Criteria
    - Identicality of applicable messages (e.g., C4I-In message serial number ***n*** should be identical to translator incoming message serial number ***n***)
    - Correct field-by-field mapping between C4I messages and CCSIL messages
- MRCI V1.3 Snapshot
  - MRCI V1.3 has few validated test messages for each protocol and relatively sparse mapping files. But initial informal test results indicate that transformations of the type described above can be achieved with 100% reliability.

Maintainability (1 of 2)

- Definition
  - Maintainability: ability to be easily corrected ***and enhanced*** [italicized text added to the MIL-STD-498 definition by SAIC]
- Applicable MRCI Requirements
  - #24: MRCI shall be developed using a language for specification of formats; and timing, and conversion requirements of data, information and C2 interchange…[This language should provide] clear, consistent and concise interface specifications of internal and external interfaces.
  - #26 MRCI shall optimize [i.e., minimize] the interdependencies between software components so that the impact of change is localized.
  - #28: MRCI shall minimize life-cycle costs and be logistically supportable
  - #36: The design of MRCI shall not preclude the addition of a module to support direct C4I system database access (vice message interchange) when specified in future C4I SOMs.
- Verification Methods and Criteria
  - Methods
    - **INSPECTION** of MRCI source code
    - **DEMONSTRATION** of rapid integration of MRCI enhancement

Maintainability (2 of 2)

- Criteria
  - Expeditious integration of a test case message id (e.g., SITREP) within a currently supported message protocol (e.g., USMTF)
- MRCI V1.3 Snapshot
  - Experience with MRCI V1.3 indicates exceptionally high degree of maintainability, particularly considering MRCI's prototype status

Availability (1 of 2)

- Definition
  - Availability: ability to be accessed and operated when needed
- Applicable MRCI System Requirements
  - #4: MRCI shall operate during, and recover from, system failures on either its RTI or live C4I side.
- Verification Methods and Criteria
  - Methods
    - **DEMONSTRATION** 1: Shutdown C4I system while connected to MRCI. Restart C4I system and re-connect to MRCI
    - **DEMONSTRATION** 2: Shutdown simulation system during federation execution. Restart simulation
  - Criteria
    - Continued operation of MRCI during Demonstration 1 and Demonstration 2
- MRCI V1.3 Snapshot
  - C4I: MRCI C4I client "registration" process ensures messages are correctly routed to a disconnected-reconnected client, but does not "save" messages that are received at the MRCI during the C4I system's period of disconnection

Availability (2 of 2)

- MRCI V1.3 Snapshot, cont'd
  - Sim: Extensive "discovery process" consumes MRCI CPU cycles as the restarting simulation federate uses RTI services to re-publish entities and their attributes. MRCI servicing of C4I clients' send and receive API calls are suspended during this process.

Flexibility

- Definition:
  - Flexibility: ability to be easily adapted to changing requirements
- Applicable MRCI System Requirements
  - #29: MRCI shall be flexible, extensible, and modifiable to capitalize on current and emerging industry accepted standards and commercially available products to the maximum extent possible to support the system requirements and to streamline upgrades
  - #30: MRCI shall provide sufficient flexibility, modifiability and performance to support changes and extensions to the interfaces on both the C4I and RTI sides
- Verification Methods and Criteria
  - (same as Maintainability above)
- MRCI V1.3 Snapshot
  - (same as Maintainability above)

Portability (1 of 2)

- Definition:
  - Portability: ability to be easily modified for a new environment
- Applicable MRCI System Requirements
  - #5: MRCI shall support C4I systems representing echelons above Corps to platform level, e.g. infantryman operating autonomously
  - #18: MRCI shall support next generation releases of C4I system software (e.g., MCS/P Baseline Build V, Block III; AFATDS V 1.0.06)
  - #32: MRCI software shall be portable to different vendor host platforms with minimal or no modifications
  - #34.1: MRCI shall provide the capability to be used with next generation simulations and the Prototype Federation products
- Verification Methods and Criteria
  - Methods
    - **INSPECTION** of MRCI source code to ensure identicality across dissimilar hardware
  - Criteria
    - Identical source code for SGI/Irix MRCI executables/libs AND Sun/Solaris executables/libs

Portability (2 of 2)

- MRCI V1.3 Snapshot
  - MRCI V1.3 source code for non-deliverable Intel/Linux version is identical to Sun/ Solaris version (except that there is not yet an Intel/Linux version of the RTI runtime libraries)
  - Currently, Motif runtime libraries must be on the host system in order for MRCI GUI to run

Testability

- Definition
  - Testability: ability to be easily and thoroughly tested
- Applicable MRCI System Requirements
  - No “testability” system requirement currently exists
- Verification Methods and Criteria
  - MRCI is inherently testable. See other performance and quality requirements.
- MRCI V1.3 Snapshot
  - MRCI V1.3 is inherently testable. See other performance and quality requirements

Principles of MRCI Reusability

Multiple Levels:

- **Level 1 (Application Level)**
  - Able to be used without modification of software for other C4I Federates.
  - Able to be used within new Federations via reconfiguration
  - Reconfiguration is via flat files (read in at initialization)

- **Level 2 (Software Design)**
  - Modularity of Major Components (Common Modules and RTI Interface)
  - API for development of new System Specific Interfaces for C4I Federates
  - Specification of future software development needs

- **Level 3 (Lifecycle/Process Methodology)**
  - Documentation Baseline
  - Infrastructure of Test & Message Development Tools
  - Integration of SOM & FOM Methodology

Different Domains of Potential MRCI Reuse

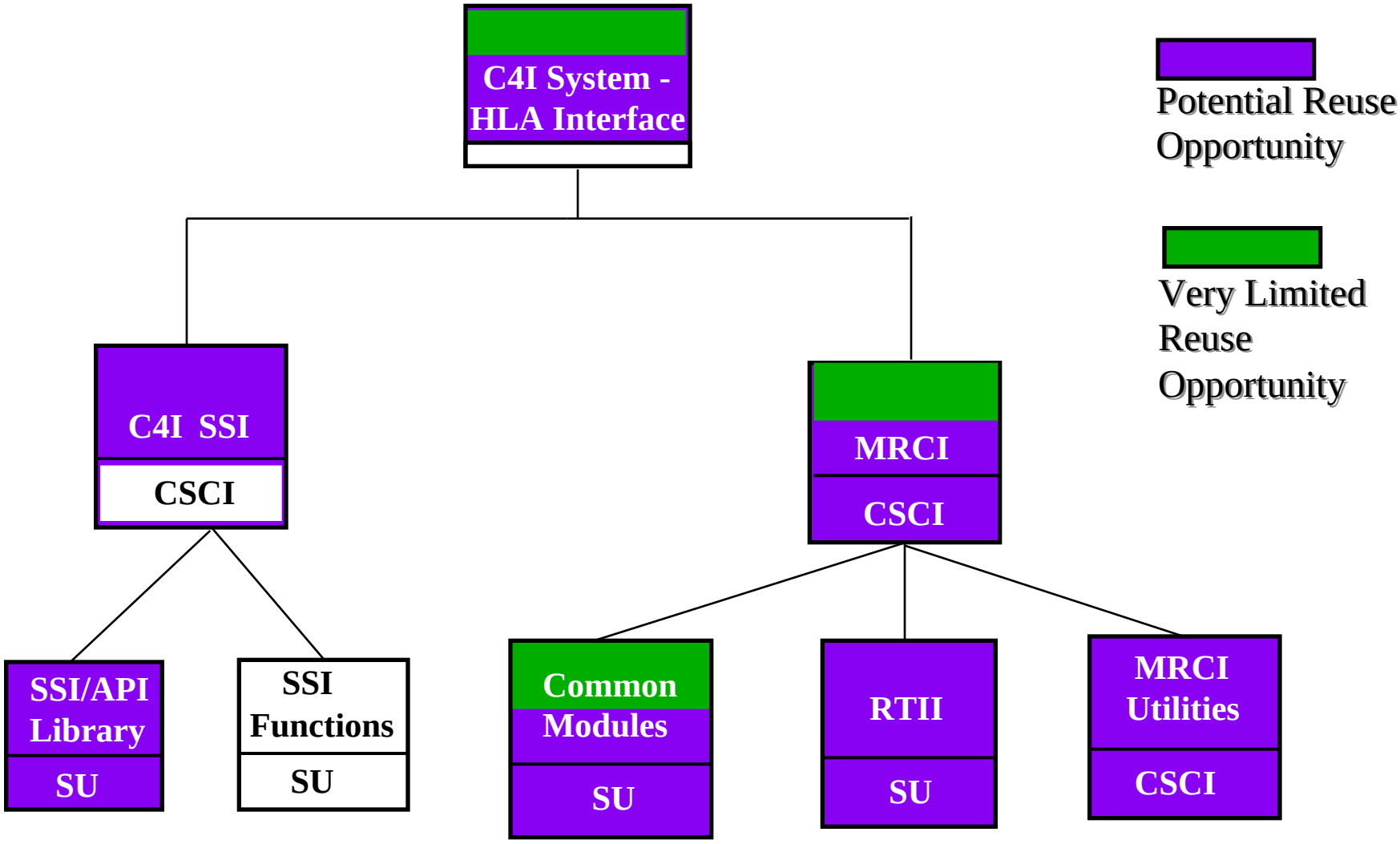
- MCS/P, AFATDS, CTAPS (MRCI's "world")
- Arbitrary C4I/MRCI Federate
- Arbitrary HLA Federation (with different RTI versions)
- M&S program developers (reusing only specific modules)

Reuse of Software Modules in C4I system federates

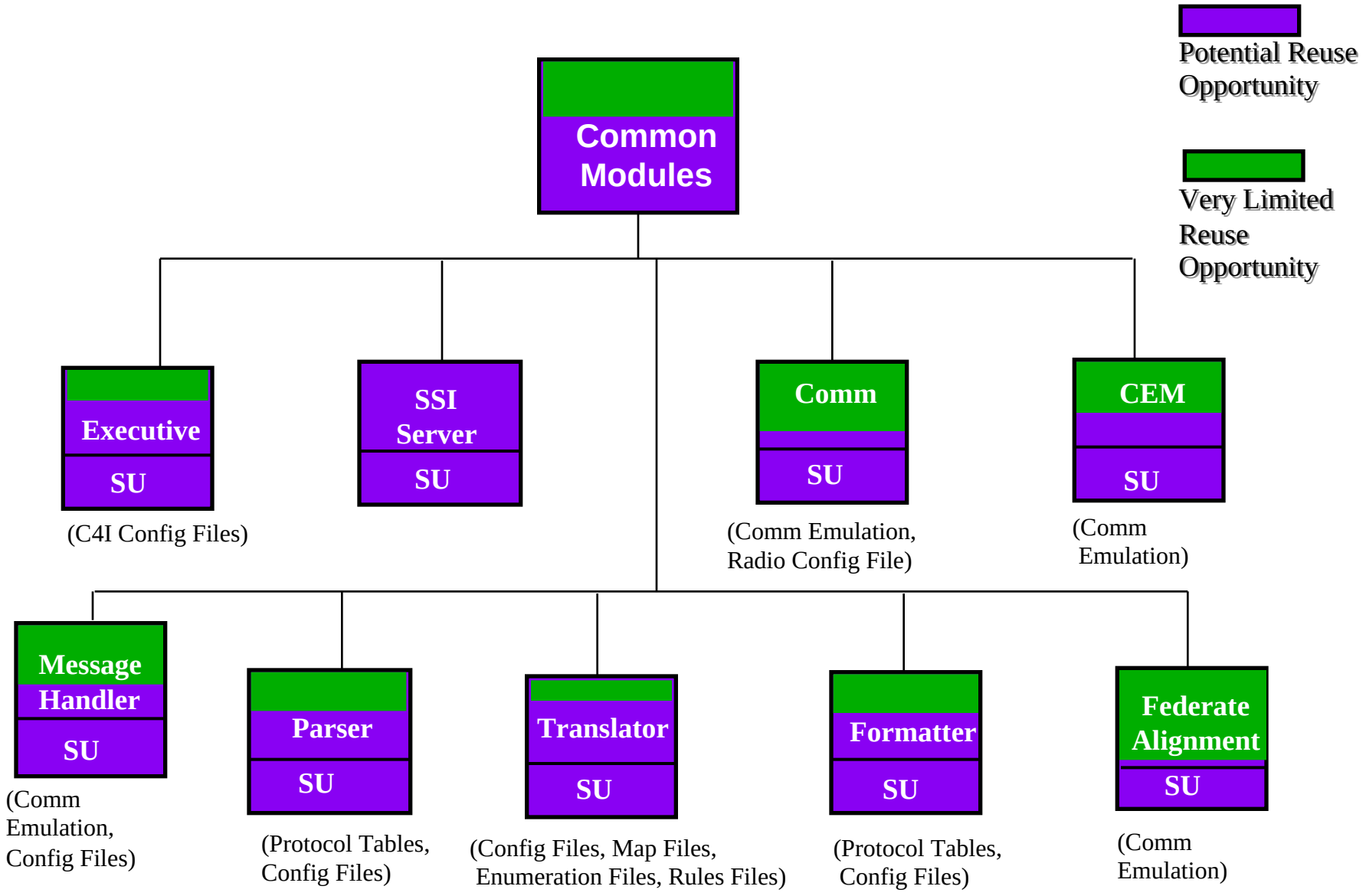
- **Reuse Context**
  - **Arbitrary C4I/MRCI federate**
- **Definitions**
  - **Purple = any C4I system will use this.**
  - **Green = some C4I systems may use this.**
  - **White = system specific**

*** Note that there may be other factors affecting reuse, such as the RTI version utilized or communications emulation approach chosen.**

Reuse of MRCI Modules – SUs



Reuse of MRCI Common Module SUs



Preliminary Reusability Assessment (1 of 2)

- **Definition**
  - **Reusability: ability to be used in multiple applications**
- **Applicable MRCI System Requirements**
  - **#20: To the extent practical, MRCI re-configurable modules shall be resuable among instances of C4I-MRCI combinations**
- **Verification Methods and Criteria**
  - **Methods**
    - **DEMONSTRATION of identical executables and runtime libraries in use on MRCIs configured to run with AFATDS, CTAPS, and MCS/P**
    - **ANALYSIS of MRCI software reuse**
      - **See DO #20 CDRL A011AA Draft (MRCI Software Reuse Study) submitted to NRaD on 3/27/97**
  - **Criteria**
    - **Functionality of all MRCI configurations, using identical exeuctables and runtime libraries**

Preliminary Reusability Assessment (2 of 2)

- MRCI V1.3 snapshot

MRCI Version 1.3 Modules		*Module reuse within specific C4I-MRCI instances*			
Module Name	*Module Long Title*	*AFATDS-MRCI*	*CTAPS-MRCI*	*MCS/P-MRCI*	*Remarks*
mcc	Communications	100%	100%	100%	
mcm	Message Handler	100%	100%	100%	One master mrci_msghdr.cfg file contains all ULP, JANAP128, and TACFIRE message header information
mct	Parser-Translator-Formatter	~100%	~100%	~100%	Separate <C4I_system>_<simulation> configuration files are used for each C4I-sim instance (e.g. mcsp_arsaf.cfg)
mex	Executive	100%	100%	100%	
mri	RTI Interface	100%	100%	100%	MRCI has, to date, used only the STOW RTI Version A1. Significant differences exist between the STOW and the HLA C2 RTI implementations, especially WRT CCSIL message processing. While this is NOT a C4I system reuse issue, it will affect MRCI reuse across various simulation federations.
msc	Server-Client API	100%	100%	100%	
xapps	Graphical User Interface	100%	100%	100%	
ssi	System Specific Interface	Unique to AFATDS except for MRCI API libraries	Unique to CTAPS except for MRCI API libraries	Unique to MCS/P except for MRCI API libraries	All C4I SSIs use the same MRCI API

AGENDA (3 of 4)

1300-1400	**Application of Quality Factors to the Evaluation of the MRCI Prototype** **Functionality** **Usability** **Reliability** **Maintainability** **Availability** **Flexibility** **Portability** **Testability** **Reusability [Special Emphasis Area]** **Context** **Modules**	**L. Griggs/M. Hieb**
1400-1430	**The Way Ahead**	**M. Cosby**

STOW Milestones

TEST EVENT	Start Test	Finish Test
FST - 1	2 June 97	6 June 97
FST - 2	7 July 97	11 July 97
FST - 3	11 August 97	15 August 97
FST - 4	18 September 97	30 September 97

HLA C2 Milestones (1 of 2)

PROGRAM MILESTONES	START DATE	FINISH DATE
PROGRAM START	**10 October 96**	**30 September 97***
PROGRAM PLANNING	**29 October 96**	**30 May 97**
Identify Federation Objectives	**29 October 96**	**1 April 97**
Identify Federation Issues	**5 March 97**	**18 April 97**
Test & Analysis Plan Development	**24 March 97**	**30 May 97**
Experiment/Study Plan Development	**28 April 97**	**2 May 97**
EXPERIMENT/SYSTEM DESIGN	**28 February 97**	**16 May 97**
Scenario Development	**5 March 97**	**25 April 97**
Conceptual Analysis Development	**7 April 97**	**2 May 97**
Federation Design	**14 April 97**	**2 May 97**
Execution Environment Specification	**28 February 97**	**18 April 97**
Experiment Requirements Identification	**7 April 97**	**30 April 97**
Experiment/System Design Specification	**12 May 97**	**16 May 97**

*** MRCI participation in data collection for report preparation ends 15 August 97**

HLA C2 Milestones (2 of 2)

PROGRAM MILESTONES	START DATE	FINISH DATE
EXPERIMENT/FEDERATION DEVELOPMENT	**28 February 97**	**11 July 97**
H/W & S/W Acquisition & Configuration	**28 February 97**	**11 April 97**
Develop FOM	**14 April 97**	**9 May 97**
Individual Federates Development	**1 April 97**	**6 June 97**
Eagle	**1 April 97**	**30 May 97**
NASM/AP	**1 April 97**	**30 May 97**
NSS	**1 April 97**	**30 May 97**
MRCI	**1 April 97**	**30 May 97**
EXPERIMENT EXECUTION	**24 March 97**	**15 August 97**
PROGRAM COMPLETION	**-----**	**15 August 97**

AGENDA (4 of 4)

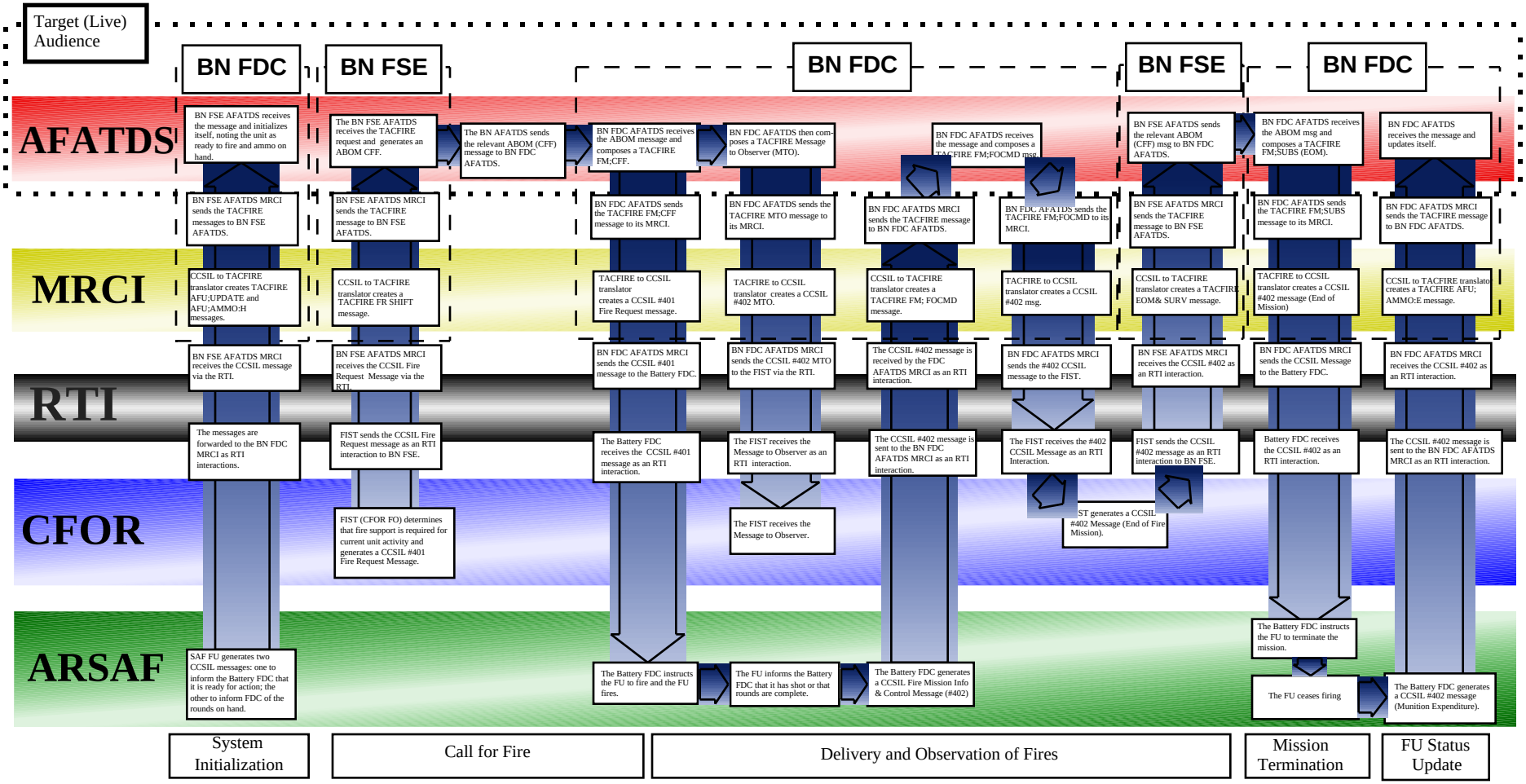
1430-1700 MRCI Experiment Testbeds

- **MCS/P - ARSAF**
- **MCS/P - CBS**
- **MCS/P - CCTT**
- **CTAPS - Test Cell (CCSIL W/S)**
- **AFATDS - Test Cell (CCSIL W/S)**
- **ACESS**

AFATDS Linkage
Scenario

- SAF firing unit sends messages informing FSE of its location and readiness status.
- CFOR FO calls for fire
- FSE receives the fire request and forwards it to FDC
- FDC passes the call for fire (CFF) to the SAF firing unit.
- Concurrently, FDC sends a Message to Observer that the mission is underway.
- SAF firing unit receives the CFF and fires the mission
- SAF firing unit informs FDC that rounds are fired.
- FDC sends a message to the FO that rounds are fired.
- FO reports effect on target and ends mission to the FSE
- FSE sends a message to the SAF firing unit that the mission is ended.
- The unit stands down.
- SAF firing unit generates a message to FDC informing them of their ammo usage.

AFATDS - ARSAF Message Interaction



AFATDS Linkage
Message Implemention (by type)

- TACFIRE AFU;UPDATE (Readiness Update)
- TACFIRE AFU;AMMO:H (Ammo On Hand)
- TACFIRE FR SHIFT (Fire Request Shift)
- TACFIRE FM;FOCMD (Fwd Obsr Commands)
- TACFIRE EOM&SURV (End of Mission & Surv)
- TACFIRE AFU;AMMO:E (Ammo Expended)
- TACFIRE FM;CFF (Call for Fire)
- TACFIRE MTO (Message to Observer)
- TACFIRE FOCMD (Fwd Obsr Commands)
- TACFIRE FM;SUBS (Subsequent Commands)
- TACFIRE FR GRID (Fire Request Grid)

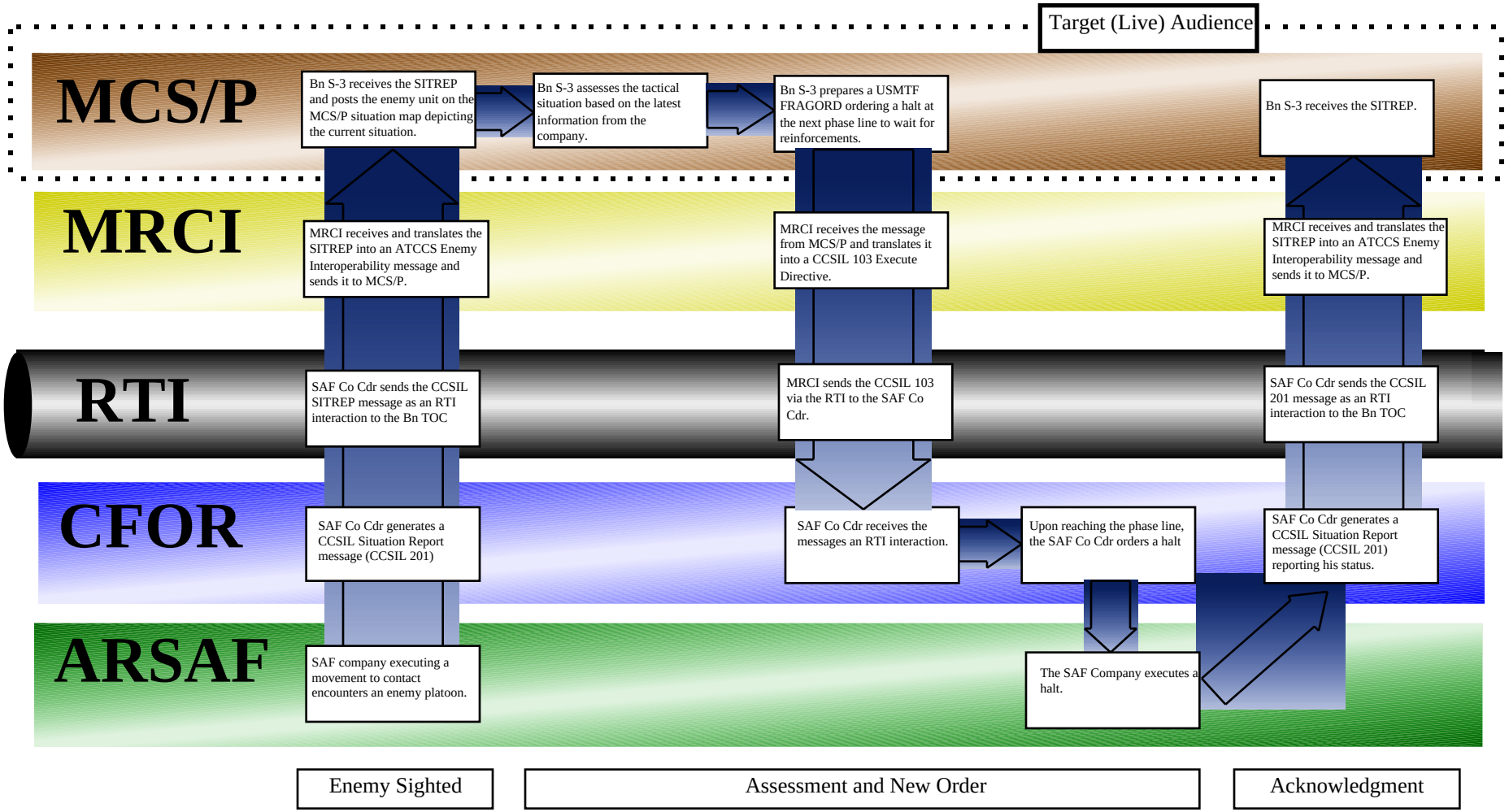
MCS/P Linkage
Scenario

- **SAF company executing a movement to contact encounters an enemy platoon and generates a SITREP to BN**
- **The BN S-3 receives the message and posts the information to MCS/P**
- **BN S-3 prepares a message to the unit ordering a halt at the next phase line.**
- **The message is transmitted to the CFOR Co Cdr**
- **The company halts at the phase line.**
- **CFOR Co Cdr sends a SITREP reporting status**
- **BN S-3 receives the SITREP and posts the data to MCS/P**

MCS/P Linkage
Message Implemention (by type)

- **USMTF C400 Situation Report**
- **USMTF A423 Operations Order**
- **ATCCS S201 Geometry Message**
- **ATCCS S302 Free Text Message**
- **ATCCS S309 Enemy InteroperabilityMessage**
- **ATCCS E500 Air Strike Warning**
- **ATCCS S507L Resources Location (Unit Loc Data)**
- **ATCCS S507R Resources Resources (Unit Resources Data)**
- **ATCCS S507S Resources Supply (Supply Point Data)**
- **ATCCS S509 Commander's Tracked Item List**

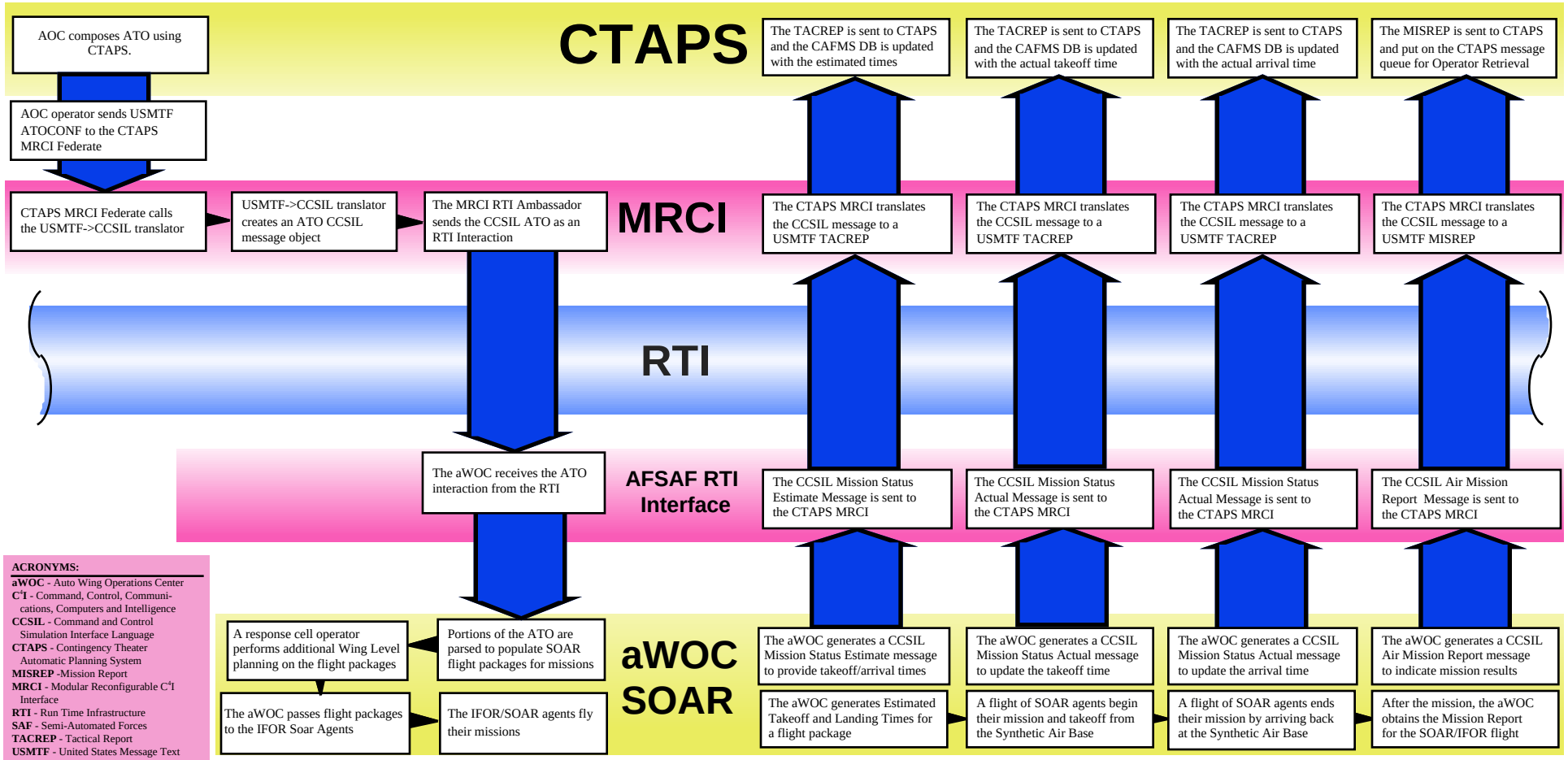
MCS/P - ARSAF Message Interaction



CTAPS Linkage
Scenario

- **AOC composes ATO Using CTAPS.**
- **The is sent from CTAPS to the aWOC (Simulated Wing Operations Center).**
- **The aWOC generates flight packages and gives them to AFSAF SOAR pilots.**
- **The aWOC generates estimated takeoff and landing times for the flight packages and sends these TACREPS to CTAPS, where they are inserted into the CAFMS DB.**
- **The AFSAF Soar pilots begin their missions and takeoff from the Synthetic Air Base. The aWOC sends the takeoff times as TACREPS to CTAPS, where they are inserted into the CAFMS DB.**
- **The AFSAF Soar pilots fly their missions.**
- **The AFSAF Soar pilots end their missions and arrive at the Synthetic Air Base. The aWOC sends the arrival times as TACREPS to CTAPS, where they are inserted into the CAFMS DB.**
- **The aWOC obtains the mission reports from the AFSAF SOAR pilots and generates mission results and sends these as MISREP to CTAPS, where they are inserted into the CTAPS message queue.**

CTAPS - AFSAF Message Interaction



ACRONYMS:

- **aWOC** - Auto Wing Operations Center
- **C^{4}I** - Command, Control, Communications, Computers and Intelligence
- **CCSIL** - Command and Control Simulation Interface Language
- **CTAPS** - Contingency Theater Automatic Planning System
- **MISREP** -Mission Report
- **MRCI** - Modular Reconfigurable C^{4}I Interface
- **RTI** - Run Time Infrastructure
- **SAF** - Semi-Automated Forces
- **TACREP** - Tactical Report
- **USMTF** - United States Message Text Format

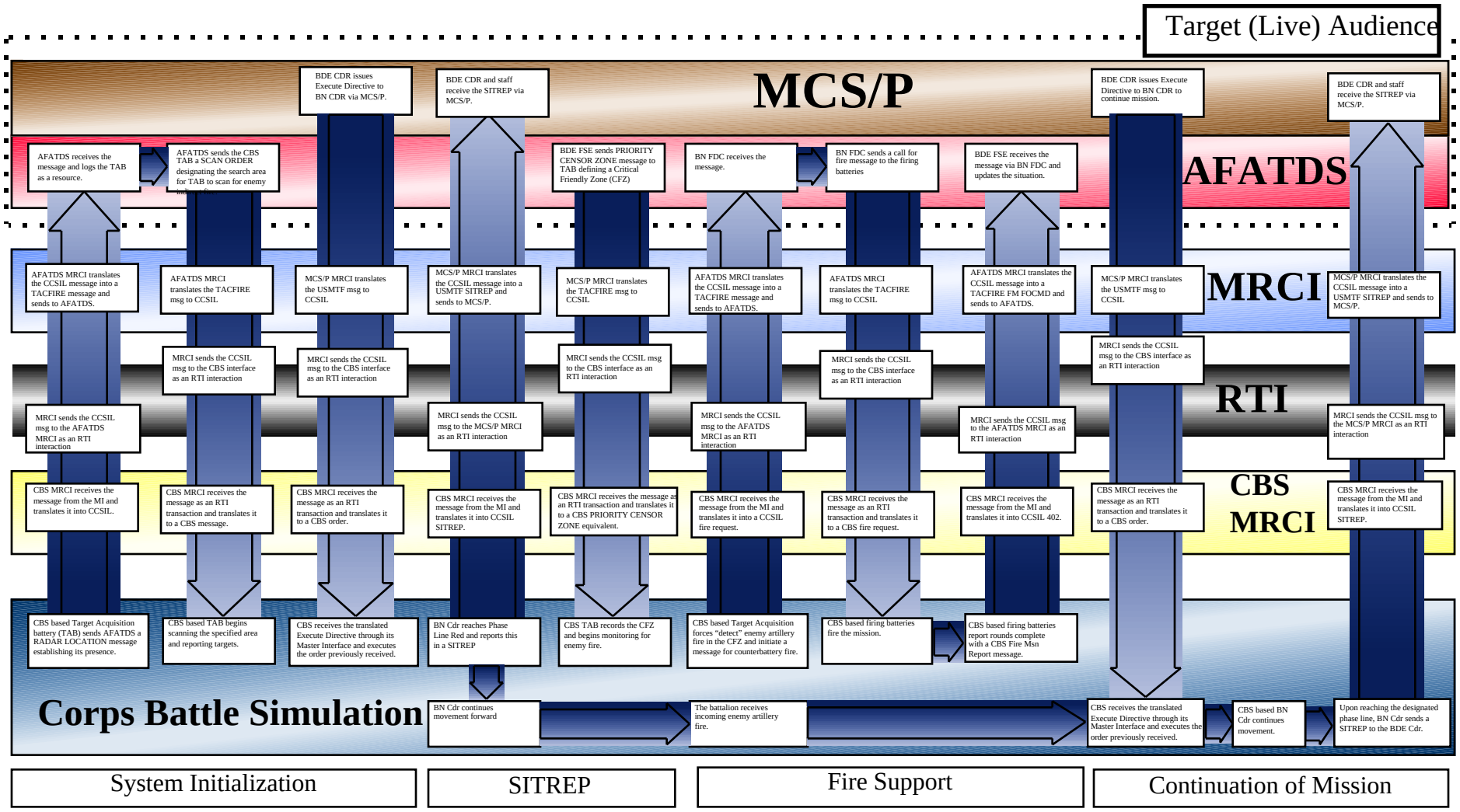
CBS Linkage
Purpose and Description

- **<u>Purpose</u>: MRCI will link to the Corps Battle Simulation (CBS) to demonstrate the capability, via a simple proof-of-principle scenario, of MRCI to link C^{4}I systems to non-HLA simulations.**
- **<u>Description</u>: Two Advanced Field Artillery Tactical Data Systems (AFATDS) and one Maneuver Control System/Phoenix (MCS/P) will provide C^{4}I gateway services to enter scenario driven commands via the MRCI, to a CBS System Specific Interface (SSI) that will relay those commands directly to CBS through the Master Interface. Reports and data generated by CBS will be sent out the same way and relayed to the appropriate C^{4}I system.**

CBS Linkage
Scenario

- **CBS Target Acquisition Battery (TAB) sends AFATDS a RADAR LOCATION message.**
- **AFATDS sends CBS TAB a SCAN ORDER designating the area to scan.**
- **CBS TAB begins sending TARGET messages to the BDE FSE (Omitted).**
- **BDE Cdr issues an execute directive to BN Cdr (CBS) to move out.**
- **BN Cdr sends SITREP to BDE Cdr that he is passing Phase Line Red.**
- **BDE FSE sends a PRIORITY CENSOR ZONE message to the CBS TAB establishing a Critical Friendly Zone (CFZ) along the Battalion's route of movement past Phase Line Red.**
- **CBS TAB detects hostile artillery fire impacting in the CFZ and sends a PRIORITY TARGET message directly to the BN FDC.**
- **BN FDC sends the fire mission to the firing battery (CBS).**
- **CBS firing battery fires the mission and reports back thru BN FDC to BDE FSE.**
- **BDE Cdr issues execute directive to BN Cdr to continue mission and report reaching objective.**
- **BN Cdr sends SITREP reporting reaching objective.**

CBS -MCS/P & AFATDS Message Interaction



CBS Linkage
Message Implemention (by type)

- **CBS Equiv to FIREFINDER RADAR LOCATION**
- **TACFIRE FM;OBCO Message**
- **TACFIRE SPRT;SEARCH**
- **CBS Equiv of FIREFINDER RADAR SEARCH AREA**
- **USMTF Execute Directive**
- **USMTF SITREP**
- **CCSIL 401 (Fire Request)**
- **CCSIL 402 (Fire Mission Info)**
- **CCSIL 103 (OPORD)**
- **CCSIL 201 (SITREP)**

CBS Linkage
Message Implemention (by type)

- **USMTF Frag Order to CCSIL 103 Execute Directive**

- **CCSIL 103 to CBS Order (equivalent)**
- **CCSIL 201 to USMTF SITREP**
- **CCSIL 401 to CBS CFF (equivalent)**
- **CCSIL 402 to TACFIRE FOCMD**
- **CCSIL 402 to TACFIRE FM;RFAF**
- **CCSIL 402 to CBS SPRT;FILTER (equivalent)**

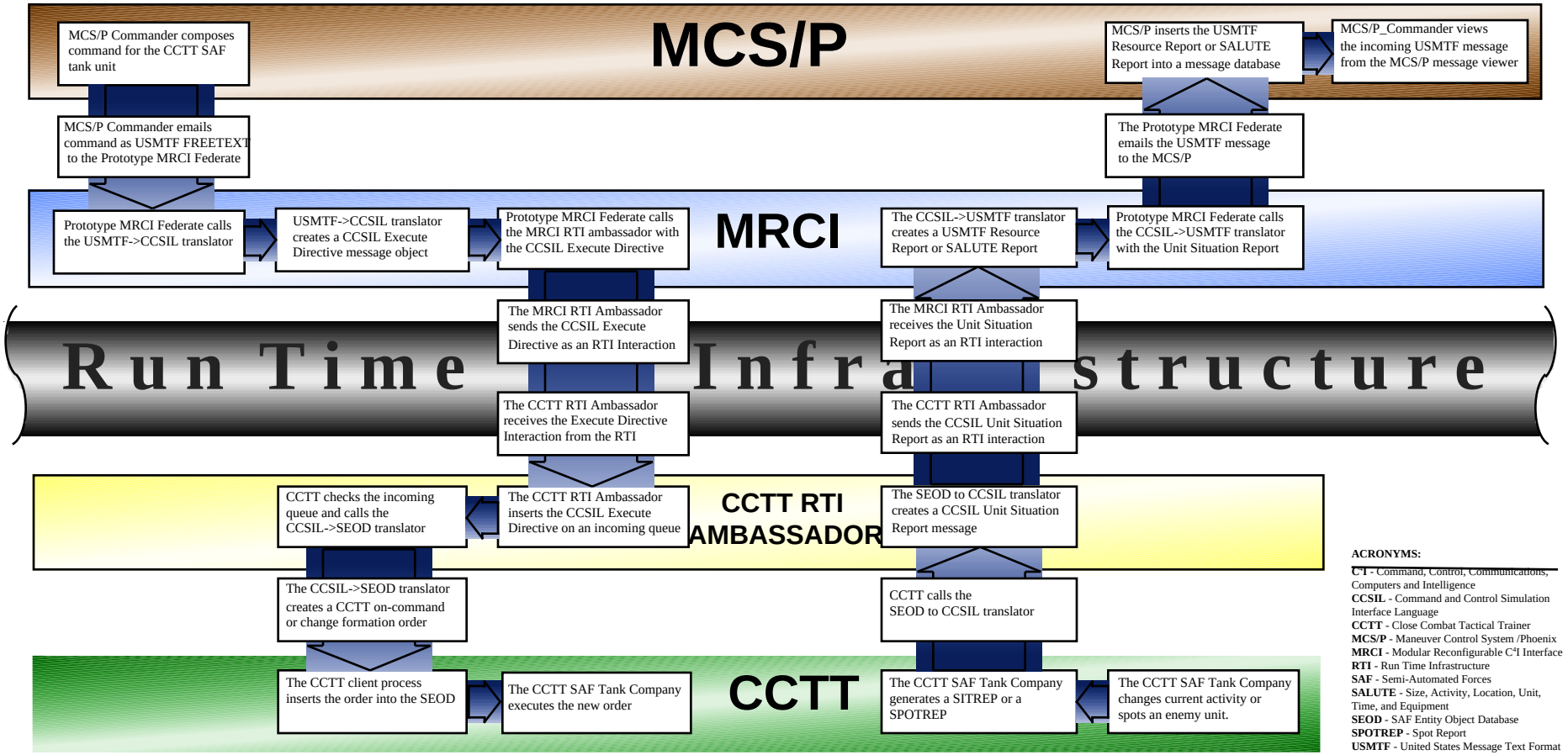
- **CBS SITREP to CCSIL 201 SITREP**
- **CBS FM;RFAF to CCSIL 402**
- **CBS FOCMD to CCSIL 402**

- **TACFIRE CFF to CCSIL 401**
- **TACFIRE SPRT;FILTER to CCSIL 402**

CCTT SAF Linkage
Scenario

- **Bn Cdr issues an Execute Directive to CCTT SAF company to execute movement.**
- **SAF company begins movement on a designated route.**
- **En route, SAF company encounters and engages an enemy platoon.**
- **SAF company reports contacts and status in SITREP**
- **Upon reaching designated halt point, SAF company halts, assumes defensive posture, and sends SITREP.**
- **Bn Cdr issues Execute Directive to continue movement.**
- **SAF company executes movement.**
- **En route, SAF company again encounters and engages and enemy platoon.**
- **SAF company reports contacts and status in SITREP**
- **Upon reaching designated halt point, SAF company halts, assumes defensive posture, and sends SITREP.**

MCS/P - CCTT SAF Message Interaction



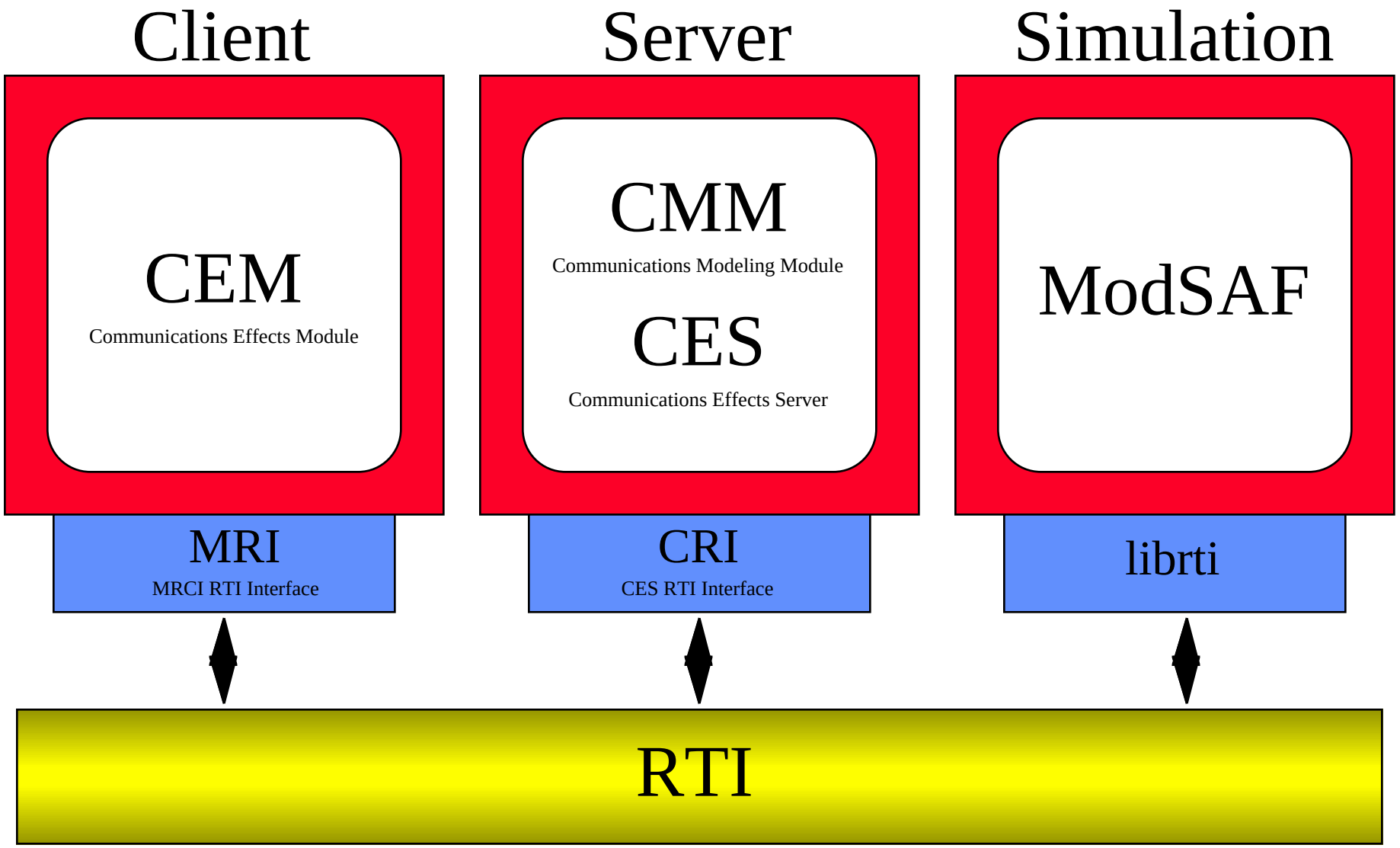
ACRONYMS:

C4I - Command, Control, Communications, Computers and Intelligence
CCSIL - Command and Control Simulation Interface Language
CCTT - Close Combat Tactical Trainer
MCS/P - Maneuver Control System /Phoenix
MRCI - Modular Reconfigurable C4I Interface
RTI - Run Time Infrastructure
SAF - Semi-Automated Forces
SALUTE - Size, Activity, Location, Unit, Time, and Equipment
SEOD - SAF Entity Object Database
SPOTREP - Spot Report
USMTF - United States Message Text Format

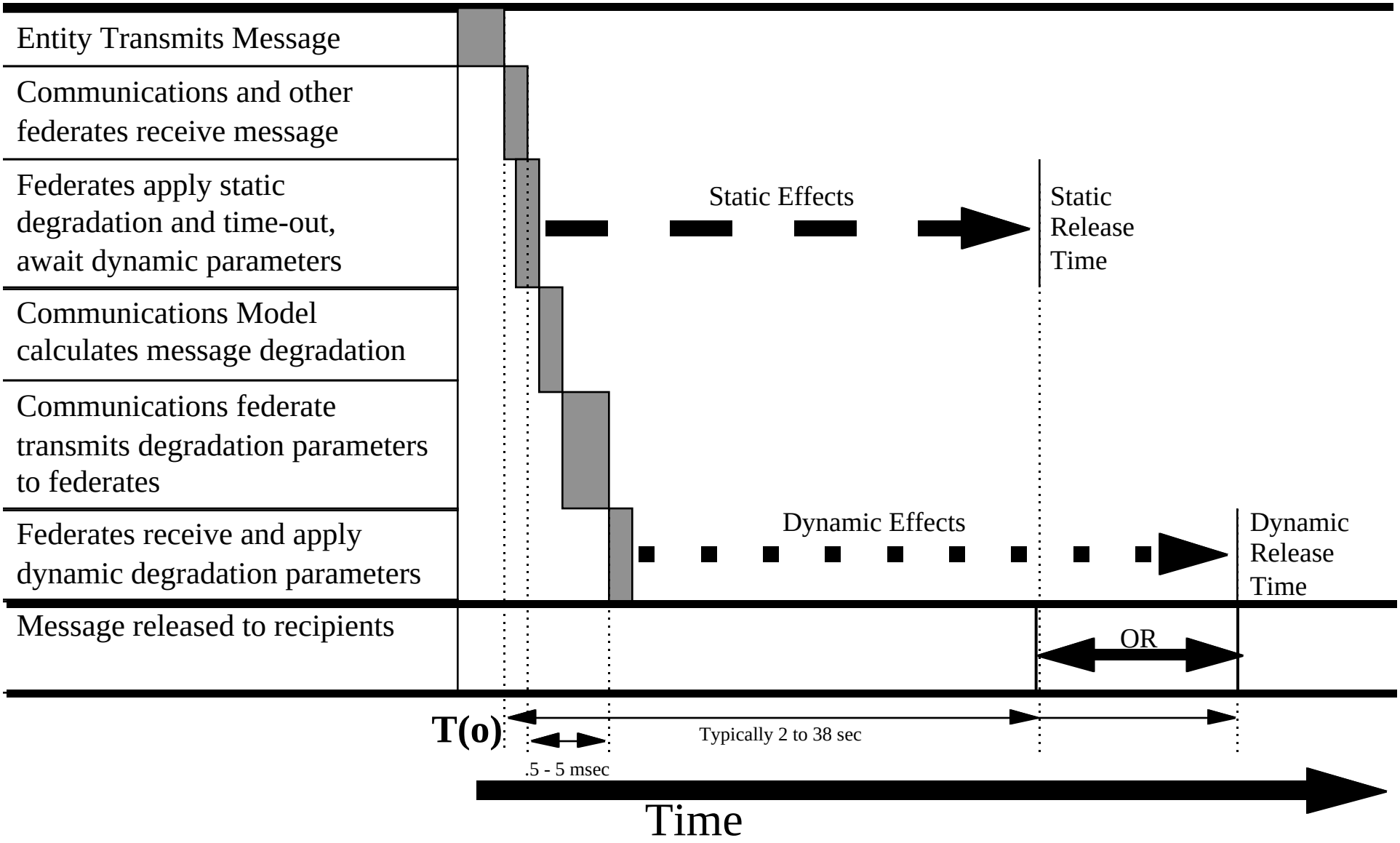
ORDER SEQUENCE OF ACTIVITY

REPORT SEQUENCE OF ACTIVITY

ACESS IPR Demonstration Configuration



Typical ACESS Timeline



Some Acronyms Used in this Presentation (1 of 3)

ACESS	**Automated Communications Effects Server System**
ACTD	**Advanced Concept Technology Demonstration**
AFSAF	**Air Force Semi-Automated Forces**
ARSAF	**Army Semi-Automated Forces**
AFATDS	**Advanced Field Artillery Tactical Data System**
API	**Application Program(mer) Interface**
aWOC	**Automated Wing Operations Center**
CBS	**Corps Battle Simulation**
CCSIL	**Command and Control Simulation Interface Language**
CCTT	**Close Combat Tactical Trainer**
COE	**Common Operating Environment**
COMPASS	**Common Operational Modeling, Planning and Simulation Strategy**
CSC	**Computer Sciences Corporation (prime of MCS/P Baseline)**
CSCI	**Computer Software Configuration Item**
CTAPS	**Contingency Theater Automated Planning System**
DII	**Defense Information Infrastructure**
DSI	**Defense Simulation Internet**

Some Acronyms Used in this Presentation (2 of 3)

FOM	**Federation Object Model**
FST	**Full System Test (STOW)**
HDC	**Hughes Defense Communications (formerly Magnavox, prime of AFATDS)**
HLA	**High Level Architecture**
IPR	**In Progress Review**
ISDN	**Integrated Services Digital Network**
IV&V	**Independent Verification and Validation**
JTASC	**Joint Training, Analysis and Simulation Center**
JTC	**Joint Training Confederation**
MCS/P	**Maneuver Control System/Phoenix**
MRCI	**Modular Reconfigurable C4I Interface**
MRMT	**Modular Reconfigurable Message Translation**
RTI	**Run-Time Infrastructure**

Some Acronyms Used in this Presentation (3 of 3)

SOM	**Simulation Object Model**
SSI	**System-Specific Interface (MRCI)**
STOW	**Synthetic Theater of War**
SU	**Software Unit**
TCIM	**Tactical Communications Interface Module**
VV&A	**Verification, Validation and Accreditation**
WPC	**Warrior Preparation Center (Einseidlerhof, Germany)**